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VOL. CXLII.—No. 3677] LONDON: FRIDAY EVENING, JULY 2, 1926 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. BOGIE RAIL and TIMBER TRUCKS.
2. WHEELS and AXLES for the above.
3. GALVANISED WROUGHT IRON TUBING.
Tenders due on the 20th July, 1926.
Tender forms obtainable from the above. 2832

Civil Service Commission. FORTHCOMING EXAMINATION. DRAUGHTSMAN in the Hydrographic Department of the Admiralty (18-25, with extension for established civil service and waiver of upper age limit for men who have served in H.M. Forces). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 29th July. 2789

Civil Service Commission. FORTHCOMING EXAMINATION. PROBATIONARY ASSISTANT ENGINEER in the Engineering Department of the General Post Office (20-23, with extension in certain cases). Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 19th August. 2780

Ministry of Health. ENGINEERING INSPECTOR. APPLICATIONS are INVITED by the Minister of Health for APPOINTMENT as ENGINEERING INSPECTOR.
The salary commences at £600 per annum and rises by yearly increments of £25 to a maximum of £1000. In addition to the salary a bonus, which varies with the cost of living, is payable. The appointment will carry the usual Civil Service conditions as to pension, holidays, &c.
Candidates must be Chartered Civil Engineers, having had wide experience in the designing and carrying out of works, especially waterworks, sewerage and sewage disposal; experience in reinforced concrete construction is desirable. Special consideration will be given to candidates with an Honours Degree in Engineering.
Preference will be given to candidates who served in His Majesty's Forces during the war.
No candidate can be considered unless he is over thirty years of age on the 1st August, 1926.
Successful candidates will be required to devote their whole time to the public service and must be prepared to take up their duties without undue delay. The headquarters of the Engineering Inspectors are in London.
Applications should be made on the prescribed form (which may be obtained from the DIRECTOR OF ESTABLISHMENTS, Ministry of Health, Whitehall, S.W. 1) not later than the 17th July, 1926. 2738

Armstrong College, NEWCASTLE-UPON-TYNE. (IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.SC. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

The NEXT SESSION COMMENCES on 5th OCTOBER, 1926.

Full particulars of the Courses may be had on application to
THE REGISTRAR,
Armstrong College
2512 Newcastle-upon-Tyne.

MANCHESTER MUNICIPAL
COLLEGE OF TECHNOLOGY.
Principal: B. MOUAT JONES, D.S.O., M.A. (Oxon).

UNIVERSITY OF MANCHESTER (FACULTY OF TECHNOLOGY).
DEGREE COURSES IN TECHNOLOGY.
The Prospectus gives particulars of the courses leading to the Manchester University Degrees (B.Sc. Tech., M.Sc. Tech., and Ph.D.) in the Faculty of Technology, in the following Departments :—
MECHANICAL ENGINEERING (Prof. C. G. Stoney, D.Sc., F.R.S.).
ELECTRICAL ENGINEERING (Prof. Miles Walker, M.A., D.Sc.).
MUNICIPAL AND SANITARY ENGINEERING (G. S. Coleman, D.Sc.).
CHEMICAL TECHNOLOGY, including General Chemical Technology, Chemistry of Textiles (Bleaching, Dyeing, Printing and Finishing), Paper Manufacture, Metallurgy and Assaying, Chemical Technology of Brewing, Electro-Chemistry, Photography, Colouring Matters, Foodstuffs and Fuels (Prof. F. L. Pyman, D.Sc., F.R.S.).
TEXTILE TECHNOLOGY (Prof. W. B. Morton, M.Sc. Tech.).

Prospectus will be forwarded free on application to the REGISTRAR, College of Technology, Manchester. 2761

Crystal Palace School of Practical Engineering. Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.,
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors. Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 2240

The Engineer

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PUBLIC NOTICES

University of Liverpool. FACULTY OF ENGINEERING.

DEAN: Professor C. O. BANNISTER, M.Eng., Assoc. R.S.M., F.I.C., M. Inst. M.M.

Prospectus and full particulars may be obtained on application to the Registrar of Courses designed for Students desiring to qualify as Mechanical, Electrical, Civil or Marine Engineers, as Naval Architects or as Metallurgists and Metallurgical Engineers. 2046

The Yarrow and the William LINDLEY SCHOLARSHIPS.
The Council of the Institution of Civil Engineers are prepared to consider APPLICATIONS for APPOINTMENT to the above SCHOLARSHIPS. These should be submitted before the 15th September, 1926, to the SECRETARY of the Institution at Great George-street, Westminster, S.W. 1, from whom the detailed regulations may be had on application.
The Yarrow Scholars must be British subjects who are not more than 23 years of age and who, desiring to become Engineers, lack sufficient means to enable them to pursue their practical training or their scientific education. The Scholarships are of values from £50-£100 per annum for one, two, or three years.
The William Lindley Scholarships are open to children (not more than 23 years of age) of Corporate Members of the Institution whose means are inadequate to defray all the expenses incidental to an engineering training. They provide for (a) a major scholarship of £80 per annum for engineering study at Cambridge University, tenable for three years; and (b) a scholarship of £40 per annum for scientific education or practical training in engineering. 2788.

University College, Nottingham. DEPARTMENT OF ENGINEERING.
APPLICATIONS are INVITED for the POST of JUNIOR LECTURER in MECHANICAL and ELECTRICAL ENGINEERING at a commencing salary of £280 per annum. The appointment is in the first place probationary for a period of one year.—Further particulars and form of application, which must be returned not later than Saturday, July 17th, may be obtained from J. E. SHIMELD, Registrar. 2781

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for :—
20 OPEN and 20 COVERED GOODS BOGIE WAGON UNDERFRAMES and BODIES (WITHOUT BOGIES, WHEELS and AXLES and VACUUM BRAKES).
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham-House, Old Broad-street, London, E.C. 2, on or after 30th June, 1926.
A fee of 20s. will be charged for the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Thursday, 8th July, 1926.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
2806 Secretary.

Great Southern Railways.
The Directors of the Great Southern Railways, Ireland, are prepared to receive TENDERS for the SUPPLY of the following MATERIAL :—
470 TONS RAILWAY FASTENINGS in Steel, or, alternatively, Iron.
Specifications, forms of Tender (on which alone offers will be considered), and drawings can be obtained on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of Two Shillings and Sixpence.
Tenders should be forwarded so as to reach the undersigned not later than 10 a.m. on Thursday, the 29th July, 1926, in the envelope provided for the purpose.
The Directors do not bind themselves to accept the lowest or any Tender.
C. E. RILEY,
Secretary.
Kingsbridge Station, Dublin,
June, 1926. 2798

Salford Union. TO HEATING ENGINEERS.
The Guardians invite TENDERS for the EXTENSION of HEATING and HOT WATER SERVICES at their administrative offices in Eccles New-road, Salford; the work to be carried out in accordance with a specification, copies of which may be obtained on application to me. The plans may be inspected at the offices of the Board's Consulting Engineer, Mr. L. Knowles, 22, Bridge-street, Manchester. Tenders must be received by me not later than Tuesday, the 13th July, 1926. The Guardians do not bind themselves to accept the lowest or any Tender.
By Order,
E. H. INCHLEY,
Clerk to the Guardians.
Poor Law Offices,
Eccles New-road, Salford,
24th June, 1926. 2797

PUBLIC NOTICES

Bethnal Green Children's HOMES, LEYTONSTONE, E. 11.
INTERNAL TELEPHONE SYSTEM.
The Bethnal Green Board of Guardians invite TENDERS for the INSTALLATION of an INTERNAL TELEPHONE SYSTEM at their Children's Homes, High-road, Leytonstone, E. 11.
Specification and form of Tender may be obtained by application to the undermentioned address, accompanied by a deposit of £2 2s., which will be returned upon receipt of a bona fide Tender, and the buildings can be viewed by appointment.
Tenders should be delivered in sealed envelopes, marked "Internal Telephone Installation," to the undersigned not later than first post on Thursday, the 29th July, 1926.
The Guardians do not bind themselves to accept the lowest or any Tender.
C. FAULKNER JONES,
Clerk to the Guardians.
Guardians' Administrative Offices,
Bishop's-road, London, E. 2,
29th June, 1926. 2827

City of Wakefield Waterworks. RYBURN SCHEME.
CONTRACT NO. 7.—TUNNEL.
The Corporation invite TENDERS for the CONSTRUCTION of a TUNNEL, 900 yards in length, with Inlet and Outlet Basins, at Barkisland, near Sowerby Bridge.
Forms of Tender, conditions of contract, specification, quantities, and other particulars may be obtained from, and the drawings may be seen at, the office of Mr. C. Clemesha Smith, M. Inst. C.E., Waterworks Engineer, Town Hall, Wakefield, on and after Monday, the 5th July, 1926, on payment of a deposit of Two Guineas, which will be returned on receipt of a bona fide Tender and the documents supplied.
The Corporation do not bind themselves to accept the lowest or any Tender.
Tenders, endorsed "Tender for Tunnel," to be delivered to me not later than Noon on Monday, the 19th July, 1926.
A. C. ALLIBONE,
Town Clerk.
Town Hall, Wakefield,
30th June, 1926. 2781

Epsom Rural District Council. BANSTEAD DRAINAGE.
CONTRACT NO. 4.
PURIFICATION WORKS.
The Epsom Rural District Council are prepared to receive TENDERS for the CONSTRUCTION of PURIFICATION WORKS consisting of Screen Chamber, Four Settlement Tanks, Four Bacterial Filters Three Humus Tanks, Sludge Pumping Station, Effluent Pipe and other works, at their sewage treatment works near Worcester Park Station, all in accordance with the plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, Carton House, Westminster, S.W. 1.
Copies of the specification, bill of quantities, and form of Tender may be obtained and the drawings may be seen at the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.
Sealed Tenders, endorsed "Purification Works," addressed to the undersigned at his office at Epsom, must be received before Noon on Monday, the 19th day of July, 1926.
The Council do not bind themselves to accept the lowest or any Tender.
By Order,
(Signed) ARTHUR R. COTTON,
Clerk to the Council.
Rural District Council Offices,
Ashley House, Ashley-road, Epsom. 2785

Epsom Urban District Council. WATERWORKS.
FERRO-CONCRETE SERVICE RESERVOIR.
The Epsom Urban District Council are prepared to receive TENDERS from contractors for the CONSTRUCTION and MAINTENANCE of a REINFORCED CONCRETE (Hennebique System) SERVICE RESERVOIR to contain two million gallons, complete with VALVE HOUSE and the necessary PIPE CONNECTIONS on land adjoining the Council's existing Service Reservoir at Downs-road, Epsom.
Contractors accustomed to this type of work desirous of tendering may see the drawings and obtain the specification, bills of quantities, and form of Tender at the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, on payment of Five Pounds, which will be returned on receipt of a bona fide Tender.
Tenders, accompanied by the specification and priced bills, must be sealed and endorsed "Tender for Service Reservoir," and addressed to the Clerk of the Council so as to reach him not later than Twelve o'clock Noon on Monday, July 19th, 1926.
The Council do not bind themselves to accept the lowest or any Tender.
E. G. WILSON,
Clerk of the Council.
37, Church-street, Epsom,
30th June, 1926. 2828

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PUBLIC NOTICES

The Danish State Railways

INVITE TENDERS FOR A DOUBLE-TRACK RAILWAY BRIDGE, &c., ACROSS LILLEBELT.

TENDERS are hereby INVITED for the CONSTRUCTION of the SUPERSTRUCTURE, SUBSTRUCTURE, as well as APPROACH SPANS, with SHORE PIERS, for a DOUBLE-TRACK RAILWAY BRIDGE across Lillebelt, in accordance with conditions, &c., open to public inspection at "Tegnestuen for Lillebeltsbroen" (the construction office of the Lillebelt Bridge), No. 4E, Bernstorffsgade, Copenhagen B, as well as at the Danish Legations in Berlin, Brussels, London, Oslo, Paris, Prague, Stockholm, and Washington.

The total length of the bridge is about 1175 m., and the weight of the steel superstructure will be about 11,000 tons.

The conditions and drawings (with Danish and English text) may be borrowed against a deposit of Danish Kroner 500, by addressing the above-mentioned construction office. The deposit will only be refunded when Tenders are submitted in due time, and the borrowed objects have been returned not later than 14 days after expiration of the time limit fixed for submission of bids.

Tenders, marked "Tilbud paa Lillebeltsbroen," may be submitted until the 1st of December, 1926, at Three o'clock p.m., at "Overingeniørens Kontor, No. 73 Trommesalen, Copenhagen B," and must be accompanied by a deposit for tendering amounting to Danish Kroner 50,000, in case the Tender includes either the entire work or the superstructure and main piers alone. If the Tender includes only the shore piers and approach spans, the deposit for tendering will be Danish Kroner 10,000.

Copenhagen in June, 1926.

THE CHIEF OF THE DEPARTMENT OF WAY AND WORKS.

2819

The Madras and Southern Mahratta Railway Company, Limited,

25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) 43 FOUR-WHEELED and 18 BOGIE UNDERFRAMES (METRE GAUGE).
(2) 3 FOUR-WHEELED and 9 BOGIE UNDERFRAMES (BROAD GAUGE).
(3) 194 PAIRS WHEELS and AXLES with SORBITIC TYRES (METRE GAUGE).

Tenders are due in on 20th July, 1926, by 2 p.m. Tender forms obtainable at above address; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

2818

Metropolitan Borough of Hackney.

BOROUGH ENGINEER AND SURVEYOR'S DEPARTMENT.

APPOINTMENT OF ENGINEERING ASSISTANT AND DRAUGHTSMEN.

The Borough Council are prepared to receive APPLICATIONS for the above-named APPOINTMENT, which under the Council's scale is a Class 1 position at a salary of £375 per annum, rising by annual increments of £15 to £450 per annum. This salary is subject to a percentage reduction of 1.38p for every five points fall below 100 in the official index figure of the cost of living. Present actual commencing salary £348 19s. per annum. All salaries are subject to a percentage reduction in accordance with the provisions of the Council's Superannuation, 1908.

Candidates should be expert surveyors, levellers, and draughtsmen, and should have had good experience in the carrying out of works of sewerage and drainage, street paving and improvements, building construction and municipal engineering work generally. Preference will be given to candidates who have passed the Associate Membership Examination of the Institution of Civil Engineers or hold the Testamur of the Institution of Municipal and County Engineers or equal diploma.

The appointment will be held during the pleasure of the Council, subject to one month's notice on either side.

The successful candidate will be required to pass satisfactorily a medical examination within 14 days of appointment and before entering upon his duties.

Applications must be made on printed forms to be obtained from the undersigned on receipt of a stamped addressed (foolscap) envelope, which must be returned on or before Monday, the 19th July, 1926.

E. R. R. TEE,
Town Clerk.

Town Hall, Hackney, E. 8,
June, 1926. 2786

Surrey County Council.

HIGHWAYS AND BRIDGES DEPARTMENT.

APPLICATIONS are INVITED for the APPOINTMENT of CHIEF ENGINEERING ASSISTANT at a commencing salary of £350 per annum, rising by annual increments of £15 to a maximum of £500 per annum. The appointment will be subject to the provisions of the Local Government and other Officers Superannuation Act, 1922, and candidates will be required to pass a medical examination.

Candidates must have had practical experience in the construction and repair of roads and bridges and should be either Associate Members of the Institution of Civil Engineers or Members of the Institution of Municipal and County Engineers.

Applications, accompanied by three recent testimonials, should be made out on the prescribed form and should reach the undersigned not later than 10th July, 1926.

T. W. WEEDING,
Clerk of the County Council.

County Hall, Kingston-on-Thames,
24th June, 1926. 2820

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS UNLESS SPECIFICALLY REQUESTED.

THE VACANCY for an ENGINEER SURVEYOR, advertised in the issue of the 4th of June, No. 2487, has now been FILLED, and the advertisers thank those who have submitted applications. 2793 A

WANTED, ASSISTANT ELECTRICAL ENGINEER, 25 to 30, with a thorough theoretical and practical knowledge of three-phase and D.C. Motors, Wattmeters, Relays, Transformers, Power House, &c.; experience in handling men and one knowing some Spanish preferred.—Write, stating experience, age, salary, to "D. A." c.o. Streets, 6, Gracechurch-street, E.C. 3. 2805 A

WANTED, SALES ENGINEER, Age 30/35. Preference will be given to man with connection amongst Municipal Engineers and County Road Surveyors in Great Britain and Ireland.—Apply by letter only, stating experience and salary required, to H. R. MARSDEN, Ltd., Soho Foundry, Leeds. 2820 A

WANTED, YOUNG MAN of Good Education with knowledge of Engineering and Metallurgy, to TRAVEL in the Far East.—Write, stating qualifications and experience and enclosing copies of testimonials, to SECRETARY, Samuel Osborn and Co., Limited, Clyde Steel Works, Sheffield. 2800 A

COMMERCIAL MAN as GENERAL MANAGER and ENGINEER as WORKS MANAGER WANTED for North-East Coast Engineering Works (varied small work) and Foundry (brass and iron), not exceeding 40 years of age. Must have initiative, energy and proved ability to manage.—Address letters, giving experience, references and salary required, 2821, The Engineer Office. 2821 A

COST CLERK (35), 20 Years' All-round Experience, engineering and shipbuilding, last 6 years as chief, DESIRES CHANGE, home or abroad.—Address, P2063, The Engineer Office. P2063 A

ENGINEERS.—PIPE LINE FITTERS for Near East. Practical experience Screwing Oil Pipe Lines essential; age 24/36, single; salary £450 progressive, plus other benefits.—Call, C. W. PETTY and CO. (Appointment Specialists), 58, Haymarket S.W. 1. 'Phone, Gerrard 3412-3. P2050 A

SITUATIONS OPEN (continued)

ENGINEER ESTIMATOR WANTED for Engineering Works in Lancashire, thoroughly conversant with Heat Transfer Problems in connection with Condenser Work; a good working knowledge of hydraulic problems essential; must also have had practical electrical experience. Applications treated in strict confidence.—Address, 2833, The Engineer Office. 2833 A

ENGINEER-SALESMAN REQUIRED for London Office of Power Transmission Company. Must have had first-class experience of Conveyor and Elevating Machinery. Previous experience as salesman essential.—Address, giving full details as to experience, education, age, and salary required, 2782, The Engineer Office. 2782 A

ENGINEER-SALESMAN WANTED for India; single, about 25. Public school boy with Railway Shops experience preferred.—Address, 2799, The Engineer Office. 2799 A

ENGINEER, with Experience in Design of Mechanical Parts of Steam Locos. and preferably with practice of Electric Locos., REQUIRED.—Address, with full particulars and salary required, 2796, The Engineer Office. 2796 A

REQUIRED, Well-educated MECHANICAL ENGINEER, age 22 to 25, having good knowledge of Hydraulic Pumps and Presses, and some business ability, for service in the Near East. Commencing salary £300 about, with free quarters.—Write, stating qualifications, where time served, Box 293 Frost-Smith Advg. Service, 66, Finsbury-pavement, E.C. 2. 2811 A

STRUCTURAL STEELWORK.—ESTIMATOR REQUIRED, accustomed to Costing and Pricing Estimates for Steel-framed Buildings, &c.; applicants holding similar positions specially preferred. Must be well versed in Reading Drawings and in Labour Costs, &c., and be responsible for complete tenders. Good salary to right man. State experience, age, when at liberty and wages required.—Address, 2824 The Engineer Office. 2824 A

TECHNICAL STAFF ASSISTANT WANTED for large works, situated between Liverpool and Manchester; should have University Science Degree, including Metallurgy, and several years' works experience in Ferrous and Non-ferrous Metals, preferably Iron, Steel or Copper Wire manufacture. State age, experience and salary required.—Address, 2823, The Engineer Office. 2823 A

WORKS CHEMIST REQUIRED.—An Important company, manufacturing special Cements, Limes, Plaster, Colours, Paints, &c., REQUIRES the SERVICES of a young RESEARCH CHEMIST. He must have sound training and experience and be prepared to take a substantial shareholding in the company. To the right man remunerative terms would be arranged. Brief details of career and qualifications are invited by letter to Box 730, Dorland's, 14, Regent-street, S.W. 1. P2048 A

WANTED, a Capable MECHANICAL DRAUGHTSMAN, preferably one having experience with Cranes and/or Concrete-mixing Machinery.—Apply, stating age, experience and salary required, to RANSOMES and RAPIER, Ltd., Waterside Works, Ipswich. 2807 A

WANTED IMMEDIATELY, DRAUGHTSMAN, under 24, for Servo Brake Drawing-office; one used to Automobile Chassis Work preferred.—Write, giving full particulars of experience and salary required, 2803, The Engineer Office. 2803 A

WANTED in North London, JIG and TOOL DRAUGHTSMAN; one with knowledge of Gas Meters preferred. State experience, age, and salary required.—Address, P2062, The Engineer Office. P2062 A

A DRAUGHTSMAN is REQUIRED by a London firm of Constructional Engineers; a good knowledge of Structural Work is essential, and some experience of Bridgework would be of advantage. Send full particulars of experience, age, and salary required.—Address, 2816, The Engineer Office. 2816 A

DRAUGHTSMAN WANTED, Age 20-25. Must be neat and accurate and quick at grasping new work; good prospects to a keen hard worker.—Address reply, giving particulars of age, experience, training and salary expected, 2822, The Engineer Office. 2822 A

DRAUGHTSMAN, with Experience in Lay-out of Electric Locomotives, REQUIRED. State experience and salary required.—Address, 2795, The Engineer Office. 2795 A

JIG and TOOL DRAUGHTSMEN WANTED for Motor Vehicle Factory.—Address, stating age, experience and salary required, 2826, The Engineer Office. 2826 A

LADY TRACER WANTED AT ONCE, Westminster. Must be first-class Tracer and Letterer, and quick.—Address, experience and salary required, P2056, The Engineer Office. P2056 A

LADY TRACER, with Good Experience, WANTED for Drawing-office in Engineering Works near London.—Address, 2830, The Engineer Office. 2830 A

SHIP DRAUGHTSMAN (Experienced) WANTED by Shipbuilders and Ship Repairers in China. Must have been trained in a small shipyard with experience in designing Light-draught Vessels. Aged 30 to 40. Salary £40 per month for 3 years' engagement.—Address, fully detailing experience and technical training, P2065, The Engineer Office. P2065 A

WANTED, First-class TOOL-ROOM FOREMAN, thoroughly competent in Tool, Jig and Fixture Design and Manufacture and fully conversant with latest machine shop methods. Must be live man who can work cheaply and accurately.—Write fully experience, age, salary required and when free, "TOOLS," c.o. Dixons, 195, Oxford-street, W. 1. P2045 A

BOILER ATTENDANTS, ENGINEERS, SHOP-ROOM HANDYMEN and CLEANERS.—For reliable time-expired Service men write:—NATIONAL ASSOCIATION FOR EMPLOYMENT OF REGULAR SAILORS, &c., (Room 6), Dock-road, Chatham. (Secretary, Commander Darwall, R.N.) Telephone, Chatham 10. All trades. No fees. P1996 A

UNIVERSAL MILLERS and TURNERS for Combination Lathe WANTED at Aircraft Works. Fine accurate work essential.—Apply, Box No. 617, W. S. Crawford, Ltd., 233, High Holborn, W.C. 1. 2791 A

STENOGRAPHER.—WANTED, a MALE EXPERT SHORTHAND WRITER and TYPIST, unmarried, age between 25 and 40, for an important office in Brazil; preference given to one previously employed in engineering office. Good salary paid to experienced man.—Apply by letter, giving full details of qualifications and past experience, to X. Z., c/o Advertisement Dept., 5, New Bridge-street, E.C. 4. 2787 A

For continuation of Small Advertisements see page 3.

£100 Prize Essay.

PETTERS LIMITED have been so greatly impressed by the growing favour shown to the two-stroke cycle oil engine, as opposed to the four-stroke cycle, by engine manufacturers, power users, and experimenters all over the world, that they recently announced in the advertisement columns of this paper a competition in which prizes to the value of £100 were to be awarded for the best essays describing the advantages of the two-stroke cycle as compared with the four-stroke cycle. The encouragement they hoped to give to engineers and others for greater activity in the study of the two-stroke principle has been responded to with notable enthusiasm, judging by the very high standard and convincing arguments of the essays received.

SIR ERNEST W. PETTER kindly consented to adjudicate the awards, and the names and addresses of the prize-winners, to whom cheques have been posted, are given below:—

First Prize of £50.

Mr. J. E. S. Dakers,
14, St. John's Road,
Newport, Mon.

Second Prize of £25.

Mr. Herbert Sammons,
Kayklan,
Preston Road, Yeovil.

Five Prizes of £5 each.

Mr. S. J. Garratt-Reed,
35, Rock Lane West,
Rock Ferry,
Birkenhead.

Mr. W. J. Paull,
"The Nest,"
Higher Severalls,
Crewkerne, Som.

Mr. E. C. Cornick,
2, Hill View,
Sherborne Road,
Yeovil.

Mr. E. G. Stowell,
10a, High Street,
Yeovil.

Mr. C. W. Chapman,
Abbey House,
Westbourne Road,
Ipswich.

In view of the general level of excellence of the numerous essays received, Messrs. Petters Limited have decided to present in addition to the above prizes originally offered, **five additional prizes of £2 each.** The names of the competitors to whom these further prizes are awarded are as follows:—

Mr. A. W. Murray,
Box 880, G.P.O.,
Adelaide, S.A.

Mr. F. Johnstone-Taylor,
Acton Bridge,
Northwich, Cheshire.

Mr. P. H. Peel,
23, Holly Road,
Ipswich.

Mr. F. J. Eastabrook,
Hazel Cottage,
Horsington,
Templecombe,
Somerset.

Mr. E. L. Brooks,
Seaforth House,
Handsworth Wood Road,
Handsworth,
Birmingham.

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THE ENGINEER.

A Seven-Day Journal

The Retirement of Mr. Thomas Carlton.

WITH the advent of July Mr. Thomas Carlton is retiring from his post as Engineer Surveyor-in-Chief of the Consultative Branch of the Marine Department of the Board of Trade, and is being succeeded in office by Mr. A. E. Laslett, who has assisted him in London for some years past. Mr. Carlton has enjoyed a very varied and interesting career. He was an apprentice at the works of Westray, Copeland and Co., Barrow-in-Furness, a firm which built not only marine engines, but also steel works and colliery plant. After completing his apprenticeship, he went to sea, and spent several years on ships of the British India and Ducal lines. In 1890 he joined the Marine Department of the Board of Trade, and was appointed to the Hull office. Eight years later he was transferred to the Consultative Department in London, and in 1912 he became Assistant to the Engineer Surveyor-in-Chief. In 1916 he was appointed Engineer Surveyor-in-Chief and Inspector of the anchor and chain cable proving establishments. He was associated with the Committee on British Marine Engineering Design and Construction which was appointed by the Institution of Naval Architects, of which he is a member of Council. More recently, Mr. Carlton was a member of the Committee appointed by the Institution of Electrical Engineers to draw up regulations governing the electrical equipment of ships. Mr. Carlton is also associated with the Marine Oil Engine Trials Committee and the Sections Committee of the British Engineering Standards Association. Great progress has been made in marine engine and boiler design during the term of Mr. Carlton's office, but he has continued to show himself in close sympathy with the new developments. At the recent Spring Meetings of the Institution of Naval Architects he expressed his confidence in the future success of the high-pressure water-tube boiler.

Tyne Tube Railway.

APPROVAL has just been given by the Ministry of Transport to a scheme for building a tube railway under the Tyne between North Shields and South Shields, and if the promoters' hopes are realised, the line should prove a great boon to the local residents. There are, of course, the Corporation ferries connecting the two towns, but the trip across takes several minutes, and the landing stages are not conveniently placed with regard to the business centres. The tube railway, which is to be of the Kearney high speed type, is to reach from Mile End-road in South Shields to Howard-street on the north side of the river, and will have a single line. The Kearney principle consists of using very steep gradients on leaving and approaching the stations, so that the force of gravity assists in accelerating and in stopping the trains. In this way it is hoped to do the journey in 50 seconds, as compared with about a quarter of an hour at present. The fare is to be 2d., and it is estimated that the cost of the tube will be £300,000. It is proposed to run a three-minute service. The ferries are to be compensated for any loss of revenue, but will, of course, have to be retained for vehicular traffic.

Motor Manufacturers' Amalgamation.

ON Friday of last week, June 25th, it was officially announced that arrangements had been completed for the amalgamation of the manufacturing facilities and resources of the Daimler Company, Coventry, and the Associated Equipment Company, of London. The Daimler Company is, and has been for some time past, controlled by the Birmingham Small Arms Company. The Associated Equipment Company belongs to the Underground Railway group of companies, and is widely known in connection with the manufacture of omnibuses for the London streets. The two companies, to be known hereafter as the Associated Daimler Company, have since the days before the war co-operated in the manufacture and sale of commercial motor vehicles and components. The object of the amalgamation is stated to be the avoidance of duplication in experiment and research, and the utilisation to the full of the facilities and experience of the two firms jointly for the manufacture of motor chassis. In order to secure efficient production by the most modern methods, a new factory, covering an area of 250,000 square feet, is now being erected at Southall. Lord Ashfield, chairman of the London General Omnibus Company and of the Associated Equipment Company, will be chairman of the amalgamated undertaking, and Sir Edward Manville, chairman of the Daimler Company, will be its vice-chairman.

Large Marine Oil Engines.

IT is announced by Vickers Ltd. that an agreement has recently been completed, under which the patents and designs of the Maschinenfabrik Augsburg-Nürnberg A.G., of Augsburg, South Germany, covering two-stroke heavy oil engines, both of the single and double-acting types, will be available for its use in the British Empire and the Colonies. The agreement covers engines for both marine and stationary purposes. It will be recalled that a six-cylinder 4400 brake horse-power M.A.N. double-acting marine oil engine was described and illustrated in our issues of March 26th and April 2nd of the present year. In addition, last week an account was given of a nine-cylinder engine of a similar type, which is used for driving a 10,000-kilowatt alternator at the Neuhof power station, Hamburg. From these accounts, it will be appreciated that British-built Vickers-M.A.N. engines, embodying the joint experience of the two firms, will be available for the largest outputs. For medium powers the Vickers four-stroke single-acting engine will also be built, while the firm will continue to develop along independent lines the light-weight fast-running type of oil engine with which its name has so long been connected.

A New Union-Castle Motor Liner.

ON Saturday last, the 26th of June, the Carnarvon Castle, the new twin-screw motor liner of the Union-Castle Mail Steamship Company, Ltd., left Harland and Wolff's yard at Belfast for Southampton. A representative company of guests made the trip, and an average speed of about 16 knots was registered, which is above the scheduled speed of 15½ knots on the South African run. During the official trials a speed of 18 knots was obtained. The new vessel has an overall length of 655ft. 9in., with a breadth of 77ft. and a depth of 45ft. 6in., and a measurement of 20,063 tons gross. She is propelled by twin-screw, eight-cylinder, Harland-B. and W. oil engines of the double-acting four-cylinder type, which are designed for a total output of 20,000 indicated horse-power. The Diesel generator sets—four in number—are arranged in a room forward of the main engines, and electrically-driven auxiliaries are fitted. In her general appearance the vessel resembles the Asturias, and, like that ship, she has a cruiser stern, two masts and two low broad funnels. There is accommodation for about 1500 persons, including the passengers and crew. As befitting a liner engaged in the South African trade, Dutch influence is strongly marked in the decoration of the public rooms. The Carnarvon Castle will leave Southampton on July 16th on her maiden voyage to South Africa.

An Interesting Wireless Experiment.

ON Monday, June 28th, interesting experiments were carried out by the British Broadcasting Company with a view to ascertaining whether any appreciable interference would take place when two transmitting stations in close proximity were working on wave lengths approximately 100 m. apart. Two programmes were transmitted simultaneously, one from the Oxford-street station and the other from the old transmitter at Marconi House. In the former case the programme was sent out on the standard 2 LO wave length of 365 m., whilst in the latter case a wave length of 460 m. was employed. An official of the company is reported to have stated that the information received from listeners goes to show that users of valve sets in all parts of London experienced little difficulty in eliminating one station or the other, and in receiving both stations at about equal strength. The experiment was, however, carried out mainly with a view to discovering whether it would be possible to provide crystal set users with a choice of programmes, and from the point of view of this class of listener the results do not appear to have been quite so satisfactory. In the south-west metropolitan area, Fulham, Wandsworth and Addiscombe, variometer-tuned crystal sets were extensively used, and the reports indicate that in some cases interference was experienced. In other parts of the south-western area there was also slight interference. The test is said to have established without doubt that the very crude form of direct-coupled crystal set will suffer interference under the conditions of the test.

Dockyard Expenditure.

INTERESTING items of finance relating to the construction and repair of H.M. ships are given in the Comptroller and Auditor-General's report on dockyard expenses for the year ended March 31st, 1925, which was issued as a Blue-book this week. The naval programme for that year is shown to have involved an estimated outlay of £13,059,019 for direct charges, and £4,453,435 for establishment and incidental costs. The actual expenditure proved to be £50,664 above the estimate. Of the labour charges, 21·5 per cent. was due to new construction and 78·4 per cent. to repairs, &c., the latter percentage being higher than in previous years. The reconditioning of 284 gun mountings, which was ordered in the winter of 1924 for relieving unemployment, cost £51,850 more than the estimate, additional work being necessitated by the bad condition of the mountings, which had been exposed to the weather for two or three years through lack of space. The conversion of the cruisers Effingham and Frobisher from coal to oil fuel led to an increase in the expenditure on these ships. A further sum of £53,390 had to be spent on submarine X 1, "due to unsuccessful trials and to modifications to machinery being found necessary." Large sums were unexpended on the five cruisers of the "Suffolk" class, one reason being the delay in awarding the contract for 8in. twin mountings. The largest underestimate was in connection with the conversion of the Furious into an aircraft carrier, an excess expenditure of no less than £225,072 being incurred, partly as a result of the numerous modifications which were found to be necessary as the work proceeded.

Wireless Fog Signals.

AN unattended wireless fog signal has been permanently established on Roseneath Beacon, in the Firth of Clyde. The installation was erected for experimental purposes in January of this year, and the trials that have since been carried out under actual working conditions have been so successful that a prolongation of the trial period is now considered unnecessary. Installations of this nature make it possible to provide unattended lighthouses and fog signals at many different situations on dangerous rocks, where expense precludes the adoption of light or fog signals which call for attention, or where it is impracticable, on account of rough seas, strong tides, &c., to maintain a submarine cable for an unattended light or fog signal. The installations on the Clyde were initiated and designed under the direction of D. and C. Stevenson, civil engineers, Edinburgh. The wireless apparatus was supplied by the Marconi Company, and the fog guns by Messrs. Moyes, of Glasgow. The need for a reliable control for lighthouse purposes has long been felt, and these three firms have had the problem in hand for a number of years. A system of control was completed in 1914, but the war and restrictions relating to the use of wireless apparatus prevented its use. The present system, designed by the Marconi Company, works on the same general principle, but valves are used in place of the coherer arrangement previously employed. No doubt its application will be extended to other branches of engineering work where the wireless control of mechanical apparatus is desirable.

The Moffat Railway Tunnel, U.S.A.

No. I.

IMPORTANT developments are being made in the driving of long railway tunnels in the United States, for the construction of the largest railway tunnel in the country was started in December, 1925, while the completion of the next longest is expected to occur in the autumn of 1926. The first of these is the 7¾-mile Cascade Tunnel of the Great Northern Railway, and the second is the Moffat Tunnel of the Denver and Salt Lake Railway, which has been driven with exceptional rapidity. Both tunnels are to shorten distance, but more especially to reduce gradients and curvature and summit elevation on lines that now climb over ranges of the Rocky Mountains, encountering unfavourable conditions of high working expenses and of continual delay, expense and trouble incident to heavy snowfall. In both cases, also, the rapid prosecution of the work is being aided by the construction of a smaller advance or pioneer tunnel parallel with the line of the main bore and connected to it by drifts or cross-cuts at intervals.

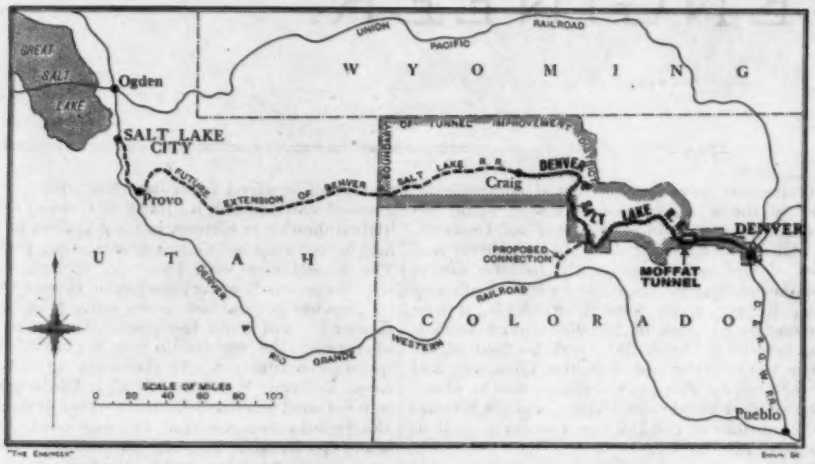


FIG. 1—MAP SHOWING POSITION OF MOFFAT TUNNEL

Although the city of Denver, capital city of Colorado, is served by several transcontinental lines, it is not on any direct or favourable route to the Pacific coast, owing to the fact that such a direct route is blocked by one of the highest and most rugged ranges of the Rocky Mountains, or the Continental Divide, which separates the drainage area of the Mississippi River and the Pacific Ocean. The Union Pacific Railroad lies far to the north and finds a practicable crossing with relatively moderate gradients. The Denver and Rio Grande Western Railroad goes south from Denver, and then makes its way westward across the mountains by a line having heavy gradients. From Denver to Salt Lake City, in Utah, the distance is about 620 miles by the Union Pacific Railroad, and 745 miles by the Denver and Rio Grande Railroad.

Some years ago a shorter and more direct line of 554 miles between these points was projected by Mr. D. M. Moffat, primarily for the advantage of the city of Denver, but secondarily to develop the settlement of a rich agricultural and mineral district on the west side of the range, which had no railway communication. This railway—now the Denver and Salt Lake Railroad—was commenced, but encountered financial difficulties; progress was slow, and with the death of Mr. Moffat it came practically to a stop. At present the line extends from Denver to Craig, 254 miles, leaving about 300 miles yet to be constructed. It crosses the range and enters the fringe of the "promised land," but the manner of its crossing is such as to involve excessive expense and difficulty in working the railway, with serious delay in the transportation of goods. A large proportion of the high working expenses is consumed in operating traffic across the summit and in clearing snow from the line on that elevated summit section. The map—Fig. 1—is explanatory of the railway situation.

Open Line versus Tunnel.—Mr. Moffat's original project for the railway included the construction of a summit tunnel six miles long, at an elevation of about 9200ft. above sea level. As the cost of such a tunnel at that time was prohibitive, and as it was important to carry the line across the range as quickly as possible, the immediate alternative was an open line about 33 miles in length, crossing the range in the Rollins Pass, at Corona, at an elevation of 11,660ft. Such a line was located. It had numerous and long gradients of 1 in 25, combined with innumerable curves. Many of the curves are as sharp as 350ft. radius; one of them is a spiral describing more than a complete circle, and others are hairpin curves in which the line doubles back upon itself, always on a rising gradient. Except for this 33-mile summit section, the maximum gradients are 1 in 50. This circuitous line and the direct low-level tunnel line are shown in Fig. 2.

There are numerous tunnels—twenty-eight of them in a stretch of 13 miles. Also several snowsheds on the higher reaches, while the summit at Corona is in a snowshed about two miles long, this part of the line being in the region of perpetual snow, a bare, wind-swept space some 1500ft. above timber line. Facilities for changing and inspecting locomotives are required there, and practically all the tracks are housed in snowsheds. Not only is the direct snowfall very heavy, but the fierce winds cause deep and solid drifts, which can be removed only by powerful steam rotary snow ploughs. It is not unusual for this part of the line to be blocked for several days, the snow drifting in as fast as it is removed, or the storms being so fierce that the snow ploughs cannot be sent out. The winter temperatures in the vicinity are sometimes as low as 50 deg. below zero Fahrenheit.

Railway working on this 33-mile summit section under such circumstances is a difficult problem, even in summer. The maximum goods train load is about 1200 tons, with three or four engines, and the train load is limited, not by the ascending gradients but by the difficulty of controlling it on the descending gradients. The heaviest tonnage movement is eastbound, so that the critical part of the line consists of 12 to 14 miles of descending 1 in 25 gradient on the eastern slope.

Since heavier trains could be taken up the corresponding gradients of the western slope, a part of the goods train equipment was furnished with special air-brake apparatus, so that the average train load could be increased to about 1600 tons. The tonnage is limited, in part, because the trains include a varying number of cars from other railways systems which are not fitted with this special brake equipment. In experiments with train loads and brakes, there was handled a train of 2430 tons—for cars and lading alone. On the ascending gradients of 1 in 25 this train was handled by seven engines—five Mallet locomotives, each of 78,000 lb. tractive effort, and two 2–8–0 locomotives, each of 44,000 lb. tractive effort.

While this present high-elevation open line is a marked example of engineering skill in building a railway quickly, and at relatively low cost, across a wild and snow-capped mountain range, it is highly unsatisfactory from the point of view of railway working, both as to expenses and difficulties, and as to continuous delays and interruptions in service.

The Moffat Tunnel.—Numerous surveys and plans were made from time to time for a summit tunnel at lower elevation to eliminate the unfavourable meteorological conditions and working difficulties of the original line, but it was not until 1923 that construction was commenced on the bold enterprise, named the Moffat Tunnel, in honour of its original projector.

The Moffat Tunnel will be 32,150ft. long between portals, on a straight line, with a rising gradient from each end. From the east portal, with rail level at elevation 9198ft. above sea level, a gradient of 0.3 per cent., or 1 in 333, extends for about three miles to the summit level at elevation 9242ft. Beyond this a descending gradient of 0.9 per cent., or 1 in 111, extends to the west portal at elevation 9085ft. The tunnel, for a single-track line of standard gauge, will have a clear height of 24ft. from floor to the crown of the semi-circular roof arch, with a minimum clear width of 16ft. in solid rock, and 16½ft. where permanent timber or concrete lining is required. Such permanent timber lining will be of Oregon fir. The floor will be levelled up with loose rock packing, as a base for the stone ballast. It is estimated that the excavation will amount to 365,500 cubic yards for the main tunnel and 157,500 cubic yards for the pioneer tunnel and cross-cuts, or a total of 523,000 cubic yards. Only short earthwork approaches are required at each end to connect the tunnel line with the existing railway.

This tunnel will save about 25 miles in distance and 2418ft. in elevation; it will replace an enormous amount of curvature by a straight line, and will reduce the maximum gradients from 1 in 25 to 1 in 50. The approach lines also will be in well timbered country, affording protection from heavy snow drifts and snow slides.

When the tunnel is put in operation, probably early in 1927, it will at first give simply improved working conditions on the line between Denver and Craig, and will not be a factor in through-route traffic. The extension of the Denver and Salt Lake Railroad to Salt Lake City to complete a new through route is a matter of the rather distant future, but in order to take early advantage of the tunnel for such service, it is proposed to build a connection from the Denver and Salt Railroad at some point west of the tunnel to the Denver and Rio Grande Western Railroad, a distance of about 45 miles. This connecting line is shown on the map—Fig. 1. The combination would then give a route of 600 miles between the two cities, as compared with the present 745 miles of the Denver and Rio Grande Western Railroad, by way of Pueblo.

FIG. 2—MAP SHOWING IMPROVEMENT EFFECTED BY MOFFAT TUNNEL

Financing and Engineering.—A novel feature of the

THE MOFFAT TUNNEL NEAR DENVER, COL., U.S.A.

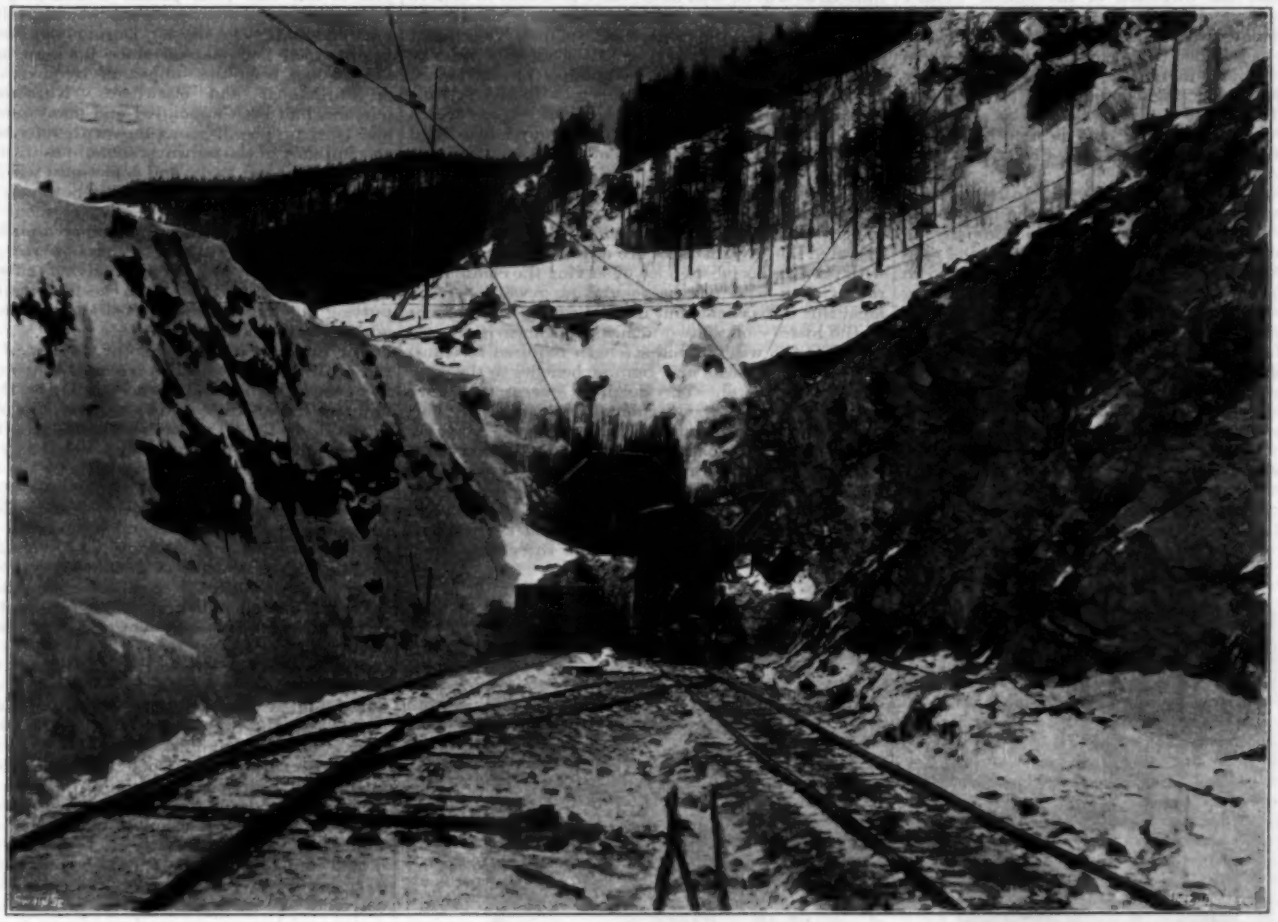


FIG. 3—EXCAVATING THE BENCH AT EAST PORTAL

Moffat Tunnel is its construction as a public enterprise and not directly by the railway interested. In fact, the tunnel is to be available for any railway wishing to use it, subject to certain conditions as to sharing the expenses.

In view of the financial condition and prospects of the Denver and Salt Lake Railroad, it was evidently improbable that the company for many years—if ever—would be able to undertake the enterprise. As a first alternative, and on the basis of the importance of this project to the city of Denver, that city by public vote engaged to issue bonds for £600,000 and to appoint a commission to have charge of the construction of the tunnel. The railway company was to pay the remainder of the cost, about £840,000. However, in the course of litigation, the State Supreme Court of Colorado held that the city could not legally issue bonds for such a purpose.

The next alternative suggested was that the State of Colorado should undertake the project as a public work, and a commission was appointed to investigate. Unfortunately, this commission went beyond its intended purpose, and discovered other cases in which railway tunnels would improve railway communication in the mountainous part of Colorado. It therefore proposed a bond issue of £3,750,000 for three tunnels. But this proved to be too comprehensive and expensive a scheme for acceptance, and on a public vote the proposition was defeated decisively.

In spite of these failures, still a third plan was suggested—and proved successful. This plan was to organise an improvement district comprising the entire area of land which could be considered as benefiting from—and therefore taxable for—the tunnel. This system of assessment for benefits is employed extensively for sewerage, land drainage and irrigation projects. With the necessary Acts passed by the State Legislature, which limited the total cost to £1,350,000, it was considered advisable to test the legality of this method of providing funds, in order to assure the value of the bonds, especially as the method had never before been employed for a railway tunnel project. A friendly suit was therefore entered upon and carried from court to court, receiving a favourable decision in each one until finally it received the approval of the State Supreme Court. The boundary of this "improvement district" is indicated in Fig. 1.

As to the operation of the tunnel, the Denver and Salt Lake Railroad Company has entered into an agreement to rent the Moffat Tunnel line from the commission for a term of fifty years at an annual rental sufficient to retire and pay interest on two-thirds of the bonds. The company will also assume all working and maintenance expenses, except that if other railways should share the use of the tunnel they will pay a share of these expenses. Furthermore, the company has agreed to pay a sum of not more than £200,000 if additional expenditures should be necessary to complete the work. The annual payments on the bonds will be about £69,000 for the first few years, then rising gradually to £107,000 and declining again to £37,000 in the last years of the term. The company has also an option on the renewal of the contract. It is expected that the remaining one

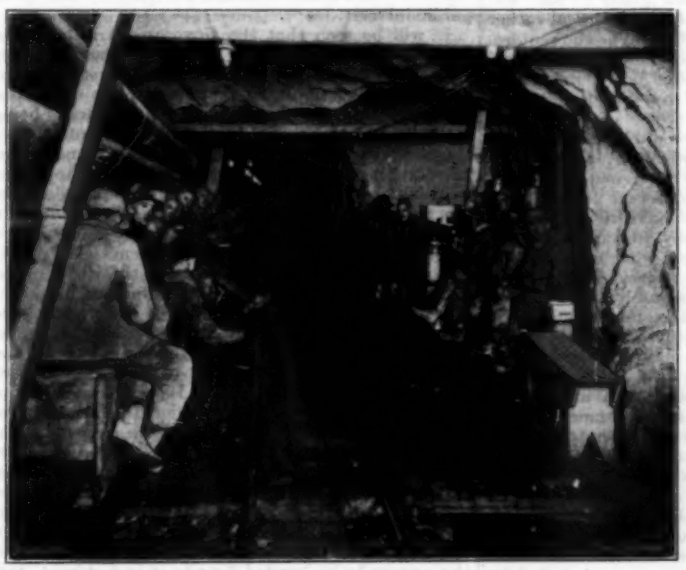


FIG. 4—LUNCHEON ROOM IN PIONEER TUNNEL

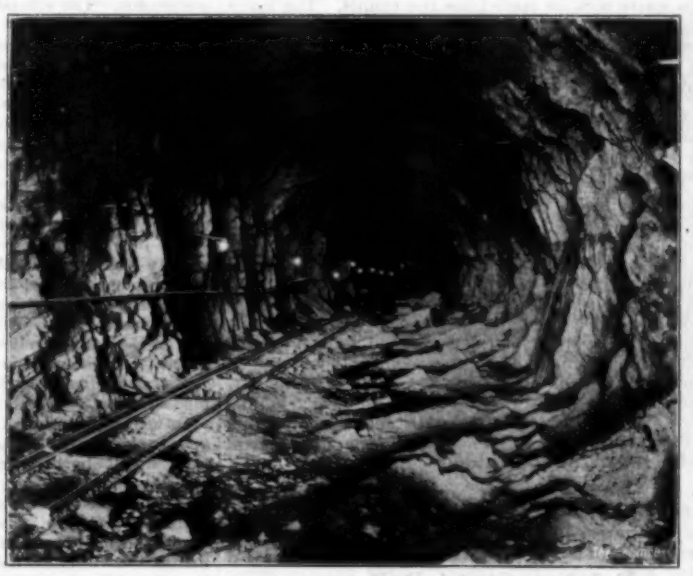


FIG. 5—FINISHED UPPER HALF OF TUNNEL IN SOLID ROCK

third of the bond issue will be taken care of by a lease of the water tunnel.

Construction of the tunnel is being carried on by contract under the direction of the Moffat Tunnel Commission, of which Mr. W. P. Robinson is president. Mr. R. H. Keays was chief engineer for about two years, when he resigned to take charge of an extensive waterworks project in Greece, then undertaken by an American contracting company. His place was taken by Mr. George Lewis, who has been general manager from the beginning and is now both chief engineer and general manager. Mr. Clifford A. Betts is assistant chief engineer.

Bonds were issued for £1,340,000. In September, 1923, the contract for construction of the tunnel was awarded to the Hitchcock and Taylor Company on a rather unusual basis. In the first place, the contractors receive a direct payment of £28,000, and in the second place they will receive half of any saving below an estimated cost of £1,050,000. Then there is a bonus of £200 for each day less than the contract period of forty-six months, and a penalty of the same amount for each day that the completion is delayed beyond the contract time. This forty-six-month period ends with July, 1927. Such rapid progress has been made that the work was two-thirds completed in March, 1926, when troubles were encountered which checked the rate of advance, as will be noted more fully later.

In the accompanying illustrations the upper view on page 12 shows the west approach, looking eastward from a point directly above the tunnel portal, the construction line entering this being seen in the middle. Beyond is the embankment being built with the waste rock or spoil from the tunnel. The lower engraving on the same page is a view looking westward toward the east portal, which is in the black spot at the middle of the picture, indicating the approach cutting. At the right of the railway are the buildings of the construction camp, while at the left are the power station and workshops. Fig. 3 is another view of the east portal, with a compressed air excavator or navvy taking out the bench to formation level.

Fig. 4 shows a luncheon room for workmen in the pioneer tunnel. This is simply an enlargement of the section, and beyond it is the regular 8ft. by 9ft. tunnel. Fig. 5 shows the upper half of the railway tunnel enlarged to full section in solid rock, at the east end, where no timber lining is required. It is ready to have the bench or lower portion excavated to formation level. The distant lights are in the 8ft. by 9ft. heading. A portion of the completed railway tunnel with timber lining and three-segment roof arch is shown in Fig. 6. The two lines of rails are of 3ft. gauge, for the 4-yard side-tip tunnel cars which handle spoil from the bench. In the distance a compressed air excavator is loading rock at the face of the bench, below the 8ft. by 8ft. central heading.

FIG. 6—PERMANENT TIMBER LINING IN TUNNEL

The "Industrialisation" of the Belgian State Railways.

By our Special Representative on the Continent.

No. I.

THE precipitous fall of the Belgian franc from 106 to the pound sterling a few weeks ago to practically 172 at the time of writing has caused renewed attention to be given to a question which has been with the Belgian Government for many years, namely, the administration of the State Railways. The connection between the two may not at first sight seem very obvious. It would be foolish to attribute the depreciation of the currency entirely or even mainly, to matters connected with the railways, but when the most important trading department of a small State is consistently losing money, the fact is bound to have its repercussion on the credit of the country. Indeed, as will be seen later, there is reason to believe that the assistance of foreign bankers which was sought to protect the franc, has been made dependent upon a satisfactory reorganisation of the railway finances. It is also the general opinion that the failure of the Government to give effect to such a scheme of reorganisation was one of the chief reasons which led to the postponement of the required loan, and that this was the prime cause of the sudden collapse of the currency.

In order to understand the present position it must be remembered that the railways of Belgium are an integral part of the governmental system. Traffic is operated and freight rates are adjusted in accordance with the true socialistic idea of serving the community rather than with a view to making profits. As an ideal this is excellent, but no democratic Government in the history of the world has yet shown itself possessed of the wisdom and strength required to translate socialistic ideals into genuine benefits to the community in general. The Belgian Governments have been no exception to the rule. Freight rates are low, to the advantage of manufacturers, but the taxpayer makes up the difference. Passenger fares are very low, but here again the traveller is really subsidised by the taxpayer. Cheap transport is not obtained by economy of working, but is granted at the expense of the community at large. It is true that there are no private shareholders expecting their three or four per cent. every year; but, on the other hand, the administration lacks the efficiency which is caused by such a stimulus. The officials have no profits to earn and no annual general meetings to face. Political rather than technical or commercial efficiency is the requirement for promotion, and a policy has to be judged rather by its effect on the ballot box than on the balance sheet. This is not to say that the Belgian State Railways are one whit worse managed than those of any other Government would be under similar conditions. It is the system which is at fault, and the Belgians themselves have for some time past recognised that something different from pure governmental management will have to be brought about if their railways are really to serve the community as they should. Those who advocate the management rather than the supervision of great commercial undertakings in England by Departments of the State, might well notice the efforts being made by the Belgians to relieve themselves from the defects of State administration.

Before the war, on February 19th, 1912, a Government Commission was established with instructions to study the question of conferring some kind of autonomy on the Belgian State Railways, so that they might be managed in accordance with commercial principles and be free from political interference. This Commission sat for nearly two years and submitted its report on December 2nd, 1913, together with a proposed Bill to be presented to Parliament. No immediate action was taken, and in less than nine months the country was invaded by the Germans, and the Belgians were engaged in a life-and-death struggle for their existence as a nation, every other interest, of course, having to be dropped.

Almost immediately after the Armistice the question of the management of the Belgian Railways was again thoroughly examined by M. Renkin, who was at the time the Minister responsible for the Department. By the beginning of June, 1919, he had prepared a scheme, in conjunction with the Ministry of Finance, which, with the support of the Cabinet, was introduced into the Chamber as a Bill or *projet de loi* on June 25th. In the preamble to the Bill it was pointed out that it had been recognised as long ago as 1846 that the management of a Department which was at once an industrial enterprise and a public service could not be carried out on the same footing as that of other Departments of the State. In that year a law had been passed establishing a *régime* which was admittedly provisional only, although it had endured ever since. During the seventy-five years which had elapsed since its inauguration its defects had been the subject of frequent discussion in Parliament and elsewhere. Numerous Commissions had been appointed and many amendments had been proposed, sometimes with reference to the accountancy of the railways, sometimes with reference to their financial basis, and sometimes with reference to their administration. Nothing, however, had come of these proposals, and the Government therefore had decided to take the opportunity afforded by the reconstruction period for a thorough reorganisation of the Railway Department, giving effect to the reforms which had so often been demanded, and putting the railways in a position of financial and administrative autonomy.

The fundamental principle of the law of 1846 was the centralisation of public receipts and expenditure in a general budget and the accounting by the Finance Minister for all expenditure and receipts dealt with in the Budget. All receipts without exception had to be put into the Treasury, and no money could be withdrawn from the Treasury without the authorisation of the Finance Minister. Such a system was entirely foreign to the efficient management of an enterprise of an industrial and commercial character, such as a railway undertaking. As long ago as 1876 M. Moncheur, Minister of Public Works, had urged that the State Railways ought to be administered and managed like an industrial enterprise, and the same idea has been advocated over and over again till the present day.

The general idea of the Renkin Bill was to convert the railways into a "Régie" or something very much like a limited company in which all the shares would be held by the State. Its board of directors would be a "Conseil d'Administration," for the acts of which the Minister of Railways would be responsible to Parliament. The ordinary operation of the railways would be in the hands of a general manager, and balance sheets, profit and loss accounts, and annual statements would be published exactly as if the railways were owned and operated by a public company. Parliament would exercise a general supervision over the activities of the Régie, partly by sanctioning its estimates and borrowings, and partly by nominating a Board of Inspectors who would see to the efficiency of its services. The Régie would have a commercial system of accountancy, a thing which public opinion insistently demanded. Thus the results of its operation could be properly appreciated and comparison would be possible with private enterprises of a similar nature. Depreciation and sinking funds would be carried by revenue, and, being eliminated from the Belgian Budget, the receipts and expenses of the railways would no longer give a false aspect to the annual revenue and expenditure of the State. The members of the "Conseil d'Administration" would be appointed and removed by the Crown at the request of the Minister of Railways. The latter would preside over their meetings, ratify their decisions or veto all such as were, in his opinion, contrary to law or to public interest.

It will be seen that the Government intended to keep a very firm hand over the railway management, through the Minister of Railways. Nevertheless, it was expressly stipulated that one of the objects of founding the Régie was to ensure the railways being worked on a commercial basis and in the interests of the public. The Government would have no power to insist on any works being carried out, or any rates reduced, except on the condition that a fair indemnity was paid to the Régie. Consequently, the attention of Parliament would be specifically drawn to charges incurred owing to railway developments of a purely political character. Such profits as the Régie might make would be allocated to building up a reserve fund of 100 million francs, and that being completed the surplus would be disposed of according to a special law. The Régie was to take over the assets and liabilities of the State system of railways, as they existed on January 1st, 1919. It was to be a debtor to the Treasury for a capital equal to the cost price of the system and the material, as shown in the Government books. To attempt a detailed re-valuation was considered to be useless, whether on the basis of present values of particular items, or upon estimated earning capacity. Hence, the lump sum figure seemed to be as good a figure as any, but it was realised that the Régie had the right to expect the system to be handed over to it in a decent state of repair. The cost of the repairs and reconstruction which were necessary owing to the war, would therefore not be borne by the Régie, but by the Government, which would eventually be reimbursed on reparations account by Germany.

As regards the status of the *personnel* of the railways under the new scheme, it was considered to approximate to that of direct Government servants. The latter, as well as the servants of the Régie, were essentially in the service of the public, but they both retained all the rights of terminating their contracts of employment which were usual in private enterprises. Moreover, the right of the members of the *personnel* to combine in defence of their interests was

explicitly recognised. Conciliation and arbitration boards, consisting half of the workers and half of the representatives of the Régie, were to be set up to deal with disputes. The President of the Supreme Board of Arbitration would, in default of agreement between the members, be appointed by the Minister of Railways. His function was to be essentially that of a conciliator "*suivant le système Anglais*," but in the last resource, if agreement could not be reached, he would give a ruling. The decisions of the Board of Arbitration were to be compulsory, and apparently were to have had the force of law. Finally, the employees of the Régie were to share in the prosperity of the railways by bonuses based upon the diminution of operating costs and the development of traffic.

The Renkin Bill, of which we have given a summary, provoked the most violent opposition. At the time the Belgian railwaymen were not in a very happy mood. The National Syndicate (trade union) of railway, postal, telegraph and marine workers, which had about 71,000 members, had a number of grievances. They were demanding payments of arrears of salaries and wages, the application of the eight-hour day, a cost-of-living bonus, and other things. A general strike had even been seriously discussed to enforce these demands, but the executive of the Syndicate had refused to countenance any such action before the Treaty of Peace with Germany had been definitely signed. By some means or other, information as to the provisions of the Renkin Bill was obtained by the Syndicate before the Bill appeared. M. Renkin was interviewed, and, despite all his explanations and assurances that no interference with the rights of the Syndicate was intended or would take place, the walls of Brussels were placarded with notices calling on the workers to unite in opposition to the proposal. The Bill, according to the placards, which were signed by the Syndicate, would suppress the freedom of the trade unions, would abolish the right to strike, would establish a "gag" system, would take away the permanence of employment, and would open the way to favouritism. It was in vain for M. Renkin to point out that his ideas were reasonable, and that no public service ought to be disorganised by a dispute with which the public were not concerned. Every strike, as he said, was finally terminated by some kind of agreement, and all that he wanted to do was to get the agreement without the strike. Conciliation was provided for as the first step, and only if that failed would a fair tribunal be called upon to make a decision binding on both parties. The public meeting, called by the placards, was held, and though it appeared that existing grievances were more acutely felt than possible new ones, there was no doubt of the hostility of the Syndicate to the Bill.

Opposition soon appeared of another kind, and from another quarter. During the period of the Occupation, the Solvay Institute of Sociology had formed a committee under the presidency of M. Leener to endeavour to formulate a scheme for converting the State railways into an autonomous organisation, withdrawn from all political influence. A preliminary scheme was indeed drawn up and published, and the authors of it clearly preferred it to that of M. Renkin. In a letter published in the local Press shortly after the introduction of the Renkin Bill, they roundly denounced the latter as giving the railway administration none of the characteristics of an effective autonomy. Such autonomy, they held, was absolutely essential to the regeneration of the railway system, and it could only be obtained by a board of directors independent of the Government and possessing great liberty of action. Under the Government scheme, the Council of Administration would be all Government nominees, and the power of intervention possessed by the Minister would deprive it of all the authority it might otherwise possess. The Solvay Committee was also of opinion that the Bill would perpetuate the present evil of parliamentary interference in matters of finance, and hence it registered its uncompromising opposition to it. When his Bill was under discussion in Parliament, M. Renkin defended it vigorously against the criticism of the Solvay Institute. The latter, he said, sought to remove the railways altogether from the control of Parliament, whereas, in his opinion, the final authority must always be that of the State. By the end of September, 1919, it looked as if the Renkin Bill had a fair chance of becoming law, substantially as drafted, but owing to the subsequent fall of the Government, no further action with regard to changing the system of railway administration took place for some time.

The next significant step was taken in November, 1921. A Royal Decree, published in the *Moniteur Belge*, of November 20th, announced the creation of a "*service centrale de Comptabilité et du Contrôle des Dépenses*," placed under the immediate authority of the Administrateur-Président of the Railways, Monsieur Bruneel. The new service was intended to be additional to, and entirely independent of, the existing accountancy department. Its import was hinted at by the words of the preamble to the Decree, which stated that "with the view of realising the programme of industrial management of the State railways, it is advisable to modify and complete the accountancy services of this department." The underlying idea seemed to be to get the railway accounts absolutely separate from the Government Budget, in order to see what the true financial position of the railways was, and to pave the way for something in the nature of a Régie.

Towards the end of 1923 it was announced in the Press that a Commission was actually engaged in studying the question of the industrialisation of the Belgian railways. Apparently, the idea of the complete severance of the railways from the State, which is implied by their administration by a Régie, had been abandoned. What was being sought was to give them something in the nature of an industrial organisation, which would permit them, with the sanction of the Minister of Finance, to raise loans in the open market for such repairs and extensions as were urgently needed. It was hinted that any delay in providing money for necessary work would land the country in a position even more grave than that of 1899, when, owing to the policy of starving the railways in the interests of the Budget, the nation was called on to pay a milliard of francs to put them in order again. A similar state of arrears occurring simultaneously with a depreciated currency, would, it was anticipated, have cost many times more than in 1899, and the Commission was urged to hasten in its task. The matter was again referred to in a speech by the King on January 1st, 1924. His Majesty stated that there were two problems of outstanding importance before the Government; one the industrialisation of the State railways, to make them capable of rendering their utmost service to manufacturers and the public, and the other the reformation of the Government departments as a result of the technical Commission appointed to report on the subject.

On February 18th, 1924, the Cabinet approved the text of a new Bill designed to place the railways on an economic footing. It provided that the assets and liabilities of the railways should be distinct from those of the State, and that the railway finances should be managed and accounted for separately from public funds. The railways should in future keep their own receipts and disburse their own expenditure within the limits of their own Budget. Receipts would have to cover ordinary expenditure, and special expenditure would be met by loans issued through the Finance Department and guaranteed by the property of the railways. The railway management would not aim at making profits, but it would be compelled to limit its receipts to its expenses, including, of course, pensions and capital charges. It would also have to provide funds for depreciation and maintenance, insurance, and reserve, the latter being to take care of heavy items of expenditure which from their nature differed greatly from year to year. Every year the estimates, balance sheet and profit and loss accounts would be submitted to Parliament, along with the report of the Minister on the year's working. The general accountancy department of the Government would audit the accounts after payment, checking the work of the railway accountants at the end of the financial year.

This Bill, as will be gathered, was designed to give the railways a great measure of control over their finances, but the administration would have remained that of a Government department. A special Commission of Parliament was appointed to consider the Bill and approved it in principle. When it came under discussion in Parliament, it met with a certain amount of opposition, but eventually all the clauses were passed, the idea being apparantly that the Bill would be at least a step in the right direction. The Bill gave, in fact, neither financial nor industrial autonomy, but there was evidently a feeling that the instability of the currency, coupled with the absence of any valuation of the railway property, would make the grant of full financial autonomy dangerous at the moment, while the temper of the House was opposed to anything in the nature of industrial autonomy. The Socialist Party indeed absolved itself from any responsibility for the industrial system of accountancy and finance, which is all that the Bill really provided.

In spite of the approval of the Bill by Parliament it suffered the fate of its predecessors and never got on to the Statute Books. The ways and means of shelving measures to which there is much tacit or open opposition, are as well understood in Belgium as in England, or any other parliamentary country. They are not killed, as that would leave the way clear for a fresh attempt at reform, but are kept in a state of suspended animation by means of *études*, commissions, reports and other devices to delay action. Consequently at the beginning of 1926 matters were almost literally in *statu quo ante bellum*, so far as railway administration was concerned. The Government was engaged in its endless task of "considering" the matter, and inventing new schemes and finding reasons for not proceeding with them. However, a new and important factor made its appearance. The Government was making a great effort to reorganise the finances of the country. The franc had been kept stable at about 107 to the pound sterling for some months past, and it was hoped to hold it permanently at that value, if not to improve it. The scheme involved a consolidation of the floating debt of Treasury bonds and depended for its success upon the negotiation of a loan of £30,000,000 from English and American bankers. The bankers, apparently, made it one of the conditions of their assistance that the administration of the State railways should be reorganised, and put on a business-like footing. Exactly what the financiers did require was not made public, but at a Cabinet meeting on March 2nd the Minister of Finance expressed himself in favour of the principle of a *Régie autonome* for the State railways, as a necessary preliminary to the consolidation of the floating debt. According to the papers at the time the Régie proposed would take the form of a company, having a capital of 10 milliards of francs, a part of which would be issued to the public. The effective management of the railways would pass out of the hands of the Government, although somehow or other, such a change was to be consistent with the State remaining "*propriétaire et maître de ses chemins de fer.*" The opposition Press attributed the sudden decision of a Socialistic Government to abandon its principles, without even consulting their party, to peremptory financial reasons, and had no hesitation in saying that the distrust by the foreign bankers of State management was the cause of the decision to run the railways as a Régie.

Institution of Naval Architects.

SUMMER MEETING IN BELGIUM.

No. II.*

WE continue below our account of the meeting of the Institution of Naval Architects at Brussels.

INCLINING EXPERIMENTS.

The third paper to be taken on Wednesday, June 23rd, was one by Professor William Hovgaard, on "Inclining Experiments on Ships of Small or Negative Stability." In the unavoidable absence of the author it was ably summarised and presented by Mr. W. J. Luke, who explained that the paper was practical in character and showed what had to be done to get anything like a satisfactory result. The considerable majority of inclining experiments were unsatisfactory mainly on account of the circumstances under which they were carried out, and in the cases discussed by Professor Hovgaard perhaps that was much more so than usual. The paper stated the standard formula, and then modified it to apply to the conditions postulated. The case in which a ship was initially upright was first considered, and a more accurate formula involving the use of a very carefully constructed curve of stability for small angles of displacement up to 5 deg. or 10 deg. was evolved. Various shapes of hull sections and submarines were then dealt with, and the author suggested that a criterion as to whether the usual formula or a more exact one was to be used was the manner in which the moment of inertia of the water line varied. If it tended to increase or decrease rapidly when the ship heeled over, then the accurate formula should be employed. The case in which a ship had an initial list was then investigated, and it was shown how to determine whether that list was caused by want of symmetry in loading or by instability. In the concluding paragraphs of the paper a numerical example was given which showed that, given certain particulars, an unwary operator might have concluded that there was really a positive metacentric height, instead of reaching the proper conclusion that it was negative in value.

Professor Percy A. Hillhouse, in opening the discussion, said that shipyard practice was based on simple fundamental theorems, and working formulæ derived therefrom. There was perhaps a tendency to follow routine processes without making certain that the assumptions made were applicable to each particular case. Professor Hovgaard had done real service, therefore, in drawing attention to the need of precaution when inclining experiments were carried out. The usual assumption was that the curve of stability for the inclining condition was, at small angles of inclination, coincident with a curve of sines, the ordinate of which at 90 deg. was equal to the metacentric height, or less exactly that the stability curve began as a straight line passed through the zero of inclination and attained to the metacentric height at an angle of 57·3 deg. In ordinary cases these assumptions served, but there were possibilities of error which were greatest in cases in which the vessel was not upright when the experiment was made. The example given in the paper showing that whereas by ordinary methods a metacentric height of + 5·4ft. was obtained, actually, the true height was — 1·0ft., was very illuminating.

Mr. H. G. Williams referred to the paper on a similar subject read by Professor Scribanti in 1904. The present paper was likely to be very useful, as there was no difficulty in assenting to the general correctness of the argument employed. His only doubt as to the practicability of Professor Hovgaard's method arose from the admission that its accuracy depended entirely on the accuracy with which a curve of stability was constructed for angles of inclination of the ship of 1 deg. or 2 deg. His impression was that, to ensure accurate results, the calculations would require to be made from a full-sized body laid off on the mould loft floor. In effect, Professor Hovgaard's method was a determination of the position of the metacentre by drawing a tangent at the origin to a curve of C_1Z, which was very difficult.

Mr. F. E. Mayer thought it would be rather useless to go into the refinements suggested by Professor

* No. I. appeared June 25th.

Hovgaard, if the existing methods of carrying out inclining experiments were still retained. He had tried the use of a clinometer in place of plumb bobs, and with an instrument curved to the length of an ordinary pendulum it was found that accurate results could be obtained. One advantage was that such an arrangement was that wind effects were eliminated.

Sir Archibald Denny, going back to first principles, suggested that instead of worrying over difficulties connected with inclining experiments, the proper course was to make the ship stable at the outset.

The session was then concluded.

In the afternoon of June 22nd, a large party, headed by the Duke and Duchess of Northumberland, were received by the King of the Belgians, the Queen and other members of the Royal Family at the palace of Laeken.

A reception took place in the evening at the Hotel de Ville, on the invitation of Burgomaster Max and the civic authorities.

Wednesday was given up to excursions to places of interest in the Brussels area, including the University buildings at Sollbosch, and the Colonial Museum at Tervueren. A reception was given by the Société des Ingénieurs et des Industriels.

On the Thursday, June 24th, Louvain and Malines were visited *en route* for Antwerp, where the meeting was continued on the next day.

In Antwerp the members assembled for the reading and discussion of papers at the Ecole Normale, Rue Quellin. The Duke of Northumberland again occupied the chair.

The President said that it was proposed to send the following telegram to the King of the Belgians:—"The President, Council and Members of the Institution of Naval Architects desire to record their respectful thanks for the magnificent welcome accorded to them on Belgian soil. Your Majesty's gracious reception left a deep impression and delightful memory on all our minds.—Northumberland, President."

Monsieur K. Bollengier then presented a paper on "The Port of Antwerp." The account given, with the aid of large scale maps, was not confined to a summary of the paper, but was a different contribution to the subject of the development of the Port of Antwerp. The main features of his address are, however, included in an abstract of the paper, which is given on page 20.

Sir Alexander Gibb congratulated the author on bringing a civil engineering subject before the Institution of Naval Architects. Although members of the Institution were interested mainly in the building of ships, they must never forget that ships were of no use without docks. The vexed question whether ships should be built to suit the docks or the docks to suit the ship was always present, although it was sometimes overlooked. The policy of the present day appeared to be that docks must be provided to keep pace with the developments in shipbuilding, but there was a limit to a policy of that kind on financial grounds. The paper brought out in most striking fashion the extraordinary success of the Port of Antwerp, which was the Mecca of dock engineering. No doubt part of the success achieved was due to the fact that the Government of the country had found capital for the dock works in the first instance, and had given assistance, not as was sometimes done in Great Britain—when money could be squeezed out of the Government—by claiming a first charge, but were willing to lend capital and take a chance with the local authority. The policy appeared to have been successful at Antwerp, and it was an example which might be followed with advantage in Great Britain. A good point about the Antwerp dock system was the fact that the docks were not cramped for access, as was the case with many British docks. That was perhaps because the civic authority were in control and did not dispose of land or allow land which might eventually be required for dock extensions to be used for other purposes. Other dock and harbour authorities had much to learn from Antwerp.

Mr. H. M. Rogers commented on the extraordinary growth of the traffic of the Port of Antwerp. The figures quoted by Monsieur Bollengier showed that 1000 ships might come to the port in a single month. Having regard to that, he was compelled, as a practical engineer engaged in shipping, to refer to the utter inadequacy of dry dock accommodation. Antwerp was notorious in that respect. There were only nine dry docks for 10,000 ships a year. The position was made worse by the fact that Antwerp was destined to become an export as well as an import port, and of the existing dry docks half might be regarded as obsolete. It was reported that more dry docks were going to be built, he supposed by the town authorities, and he would say at once that neither shipowners nor ship repairers liked public graving docks. The docks were used by a number of ship repairers, and owing to local regulations it was difficult for foreign shipowners to get a turn for any particular job. Shipowners preferred to go to repairers who had their own dry docks as at Rotterdam, which was a good port in that respect. Instead of five possible dry docks, Antwerp wanted at least twenty, and should have pontoons and floating docks. Instead of building more dry docks at the large cost of such works, the city authorities should allow money to be raised by business interests and applied to the building of floating and pontoon docks. If twenty such docks were built there would be plenty of work for all of them. Under present conditions many vessels needing repairs which could be carried out at Antwerp were compelled to go to other ports. Millions of pounds of work had been diverted.

Monsieur Bollengier, in his reply to the discussion, said that with regard to the criticism of Mr. Rogers, he was in sympathy with his complaint as to the need of additional dry-docking facilities, but it had to be borne in mind that there had been financial stringency, and that the resources available for dock works had all been allocated. On the question whether ordinary dry docks or floating docks should be provided, there was an economic problem to be solved. The excavated graving dock was higher in first cost, but once it was built it involved hardly any outlay on upkeep, whereas the cheaper floating dock required a definite annual expenditure on repairs and maintenance. There was the further consideration that natural conditions at Antwerp made dry dock construction a fairly simple engineering job. The character of the foundations and general conditions were all favourable; on the other hand, at Amsterdam and Rotterdam the conditions were difficult for the construction of ordinary dry docks, which explained the preference which had been shown in the past for floating docks.

The President, in concluding the discussion, referred to the interest created by the paper, and the meeting gave a cordial vote of thanks to Monsieur Bollengier.

The next paper to be taken was that on "Oil Separators for Bilge and Ballast Water," by Dr. H. S. Hele-Shaw and Mr. Albert Beale. The contents of the paper are given in the following summary.

OIL SEPARATORS.

In this paper on oil separators for bilge and ballast water, the authors begin by outlining the well-known harmful features resulting from oil pollution. Legislative measures dealing with oil pollution in coastal waters are then dealt with, and brief reference is made to the International Conference on Oil Pollution which was recently held in Washington. It is argued that efficient oil separators being available, they should be more generally adopted by shipowners. The use of such appliances is recommended on the grounds of economy resulting from the recovery of oil and the additional flexibility given in working the fuel and ballast tanks. The conditions which should be fulfilled by an efficient separator are then discussed, and the principles of design underlying the gravitational process of separation developed. Outline drawings and a short description of various types of oil separators are given and special sections of the paper are devoted to the questions of eddy motions in oil separators. It is shown that if stream-line flow in a circular pipe is to be maintained and eddying prevented, that for a throughput of 200 tons per hour, a total diameter of 100ft. is needed. From such considerations a multi-tubular construction, such as that adopted in the stream line oil separator, described in our Shipping Exhibition Supplement of November 20th, 1925, is recommended. For filtration it is sugges that inorganic material which can be cleaned by passing steam through it is the best material to use. With proper separation and filtration it is stated that it is now possible to reduce the oil content in the final water discharge to not more than 1 part in 200,000 parts of water.

Sir E. Tennyson d'Eyncourt said that, as an old friend of the author, he would like to say something about his important work in the field covered by the paper. The mere fact that legislation had been carried out in Great Britain and the United States pointed to the urgency of the problem involved. It appeared from the paper that the existing rules were regarded as insufficient. The device described in the paper enabled the oil to be dealt with in an effective way.

Mr. W. J. Willett Bruce, dealing with the subject from the shipowners' point of view, said that during the last five years the revision of shipping laws had called for large expenditure by British shipowners. Such increased expenditure came at a period when it could be ill-afforded. Even at the present time the shipowner was faced with the cost of compliance with new fire-extinguishing regulations and Factory Act requirements, which in a number of instances overlapped the Board of Trade regulations. The International Conference at Washington on Oil Pollution had been held, but whatever recommendations arose out of that meeting, unless they were the subject of international legislation, the results would be futile. Referring to the statement of the author that shipowners had failed to eliminate oil pollution, he had no hesitation in stating that the shipowner had done his best to minimise the oil nuisance by issuing rigid instructions to those in charge of ships. This action, coupled with the work of harbour and port authorities, who exercised strict vigilance, had given highly satisfactory results, particularly in regard to passenger liners. It had been definitely ascertained that the main cause of oil pollution was the discharge from oil tankers and occasional carriers using both double bottoms and deep tanks, and naval craft which were entirely outside existing regulation. In the case of passenger liners using oil fuel bought at high prices, strenuous efforts were naturally made to prevent any loss by undue waste. Under present-day conditions what little bilge water had to be dealt with was pumped into one of the double bottom tanks, isolated and reserved for that purpose, and was finally pumped out not less than 150 miles from the nearest coast. With regard to coastal services, owing to their short distance voyages, the problem resolved itself into allowing an accumulation of bilge water, and finally discharging it into a suitable separating barge provided by those interested or privately owned. In view of these conditions, it was hardly necessary, as suggested, to install separators on each ship. Again, it was admitted that a separator on board a vessel should not only free the oily water of the oil, but should free the oil so separated from both water, dirt and other solid matter. The authors stated that the value of the oil recovered by the process advocated would soon be written off, the plant eventually yielding a substantial profit. That might be possible in instances when storage compartments were alternatively used for oil and water ballast, but not in instances where it was only a question of bilge water. On the question of the most remunerative way to deal with the oil recovered, it was generally arranged to utilise it in the steamer's boiler furnaces, and the muddy residue which remained was dumped overboard. Hence the importance, if a separator were installed, of having one capable of dealing with the solid matter before it reached the burners. With reference to the stream-line separator, like its predecessors it occupied very considerable space in cases where large volumes of contaminated water had to be dealt with. The filtration medium was also another moot point, involving additional labour and cost of material. He suggested that it would be preferable to use something which would not take any cleaning, such as sand or coke.

Dr. H. S. Hele-Shaw, replying to Mr. Willett Bruce, referred to his own association with the port of Liverpool. It would hardly, he said, be suggested that he was ignorant of the opinion of shipowners on the subject raised in the paper or unacquainted with the difficulties with which shipowners were confronted.

Mr. Beale, the joint author of the paper, dealt with other points, and said an installation on the system described would not be very large and not very expensive. With regard to the filtering medium, it was an advantage that it could be cleaned by the simple application of steam, and that no dismantling was involved, as would be the case if sand or coke were used.

The last paper on the agenda was one by Mr. Lockwood Taylor, describing "Some Ship Strain Observations with a Simple Instrument," of which a short abstract is appended.

SHIP STRAIN OBSERVATIONS.

The experiments described in this paper form part of the author's work as holder of the 1851 Post-graduate Research Scholarship (1924).

The strainmeter with which the various observations were made is shown in Fig. 1.

The essential part of the instrument is the flat spring S of length 4in., to the ends of which is transmitted the strain over a length of from 24in. to 36in. as may be convenient, by means of the rod or plunger P sliding within a tubular guide G, which carries at its other end a micrometer of a standard pattern. Magnification is effected by pointers attached to the ends of the spring, the degree depending on the length of spring and pointers, and also varying from point to point of the scale. The mean magnification actually adopted is about 100, but a greater enlargement may be used for strains smaller than the maximum available range, by using the more openly divided end of the scale.

The two "centres" of the instrument—the end of the rod R and of the micrometer M respectively—are pressed by the spring, which thus serves the double purpose of magnification and of holding the instrument in place against convenient "abutments," which may be studs screwed into tapped holes—Fig. 2—pieces of packing clamped to the material of the structure—Fig. 3—or, more generally, members riveted to the longitudinal structural material, such as flanges of beams and frames—Fig. 4—lugs, and butt ends of plating—Fig. 5—which have all proved satisfactory in various instances, showing that, as would be expected from published experiments, the riveted attachment does not, in general, permit slipping, although, of course, except in the case of the plating butts, there is no calculable force tending to produce such slipping. Rotation of the instrument is guarded against by setting the "centres" in centre punch depressions and so obtaining "ring contact."

The coarse adjustment, for instance, to suit the frame spacing of the vessel, is effected by the turnbuckle with lock nuts, while the fine adjustment is by the micrometer screw, which is also used for calibrating with the instrument in position between rigid centres, such as those of a lathe.

The spring, exerting as it does a very approximately constant force of some 40 lb., has only to overcome the slight friction of the sliding joint which is due to the instrument's own weight—about 1½ lb. to 2 lb.—and any possible slight friction between the scale and pointer, so that the instrument is very positive in its action, and has been found to follow, for instance, the straining of a vessel in a seaway very smoothly. The aluminium pointers are so light that rotation even with the instrument in a horizontal plane, or with heavy rolling in a seaway, is adequately prevented by friction between the "centres" and structural material.

The instrument is rendered self-calibrating by means of the micrometer, and the calibration can at any time be verified, and the working of the instrument tested in position. The strainmeter follows with every appearance of accuracy stress variations of a vibratory character, due to hull vibration, of which the two-node vertical type is normally of a period which the eye can follow, if not of too great amplitude. This is as would be anticipated from the value of the instrument's own natural period, which is of the order of $^1/_{300}$ second, as actually designed.

The effective span of the instrument in use may not always be precisely the distance between the centres, as the character of the "abutments" employed must be considered. The span is the distance between the centres of the studs—Fig. 3—or the clamps—Fig. 4—and where, say, a lug or section riveted to the plating—Fig. 5—is used, the centre line of riveting is taken. In the case of successive frames or beams facing in the same direction, the actual frame spacing is the correct span, while in the case of one end of the instrument bearing against an overlapped butt end, the centre of the butt, from considerations of symmetry, is the correct point from which to measure.

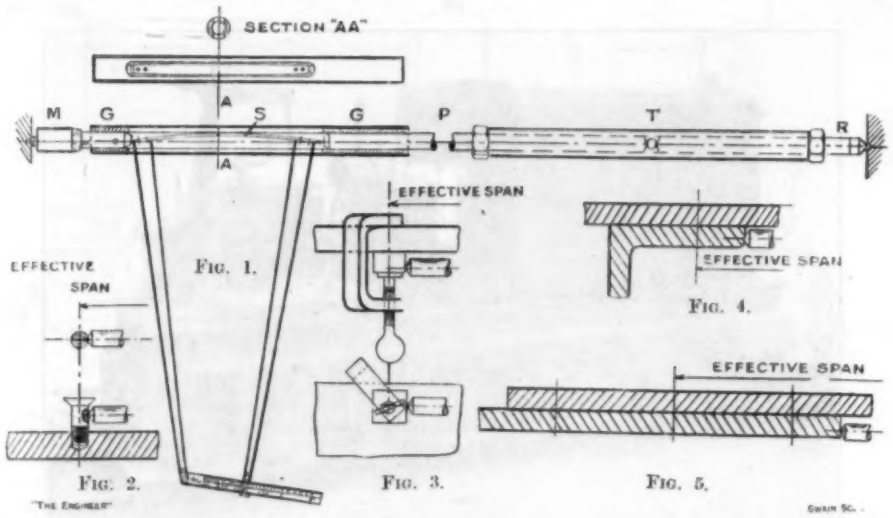
In observing strains it is always the difference between the initial and final condition which is measured. Absolute strains, i.e., starting from a condition of zero strain—and stress—may be inferred by obtaining the proportion of the observed range of strain to the corresponding range of bending moment, where this can be calculated, and using this ratio to deduce the absolute value for a known absolute bending moment. In the results given, ranges of strain and of bending moment have, in general, alone been dealt with, since it is the ratio between the two or its reciprocal, the "virtual section modulus," which is the point of interest, rather than the absolute stress, in still-water experiments.

At sea it is the range of strain which is observed which is of primary interest and importance, since it may be used in con-

junction with a known still-water stress to obtain an absolute figure in a given case.

A standard value of the modulus of elasticity of 13,000 tons per square inch is used.

The paper includes the results of a set of still-water experiments, giving the loading strains for a self-trimming collier, a cargo vessel with hatches of normal width, and for two oil tankers, one with transverse and one with longitudinal framing. Observations made at sea on voyages in the Furness-Withy fast cargo vessel London Mariner are given in tabular form. Results are also given of readings obtained in the vessels Kenmore and Ravonia, and the two oil tankers San Fraterno and San Tirso. In an appendix some observations of the deflections obtained when loading the tanks of a ship are given, and are compared with the values obtained by calculation.



TAYLOR'S STRAINMETER

Professor W. E. Dalby congratulated the author on having taken up a fascinating field of research in which a great deal of work was being done at the present time. It had been pointed out long ago by Hirn that a material could be made to show the strain to which it was being subjected at any moment by measuring the distortion of the part to which the stress was being transmitted. That method had been employed to measure stresses in pumping engines. Care must, however, be taken in an investigation on those lines to make the most accurate measurements, as the distortion was in most cases extremely small. In illustration of that fact, he would say that if you took two points 10in. apart on a bar, a stress of 1 ton was accompanied by an expansion of only 1000th of an inch, and its determination called for the employment of very delicate and finely adjusted apparatus. It had been found in work on bridge stresses that the design of a reliable instrument was a difficult task, and called for a special investigation. His experience in the matter raised the question whether the author in his desire to achieve simplicity had not to some extent sacrificed accuracy.

Mr. Wilfred Ayre referred to the tendency during a recent period for buckling stresses to assume more importance than in earlier years. He was particularly interested in the effect of hatch combings, and noted that the author's results went to confirm those which had been obtained in practice.

Mr. H. Foster King referred to his own work in connection with the investigation of stresses by means of strain meters, and to an investigation to determine the effect of using the new shipbuilding steel which was claimed to possess greater elasticity and higher tensile strength than the material ordinarily used. The measurement of strains on board ship was a difficult process, as there were variables produced by differences of temperature, and the physical impossibility of knowing at any time with accuracy other conditions which must affect the results had also to be remembered.

Sir Archibald Denny said the results given in the paper recalled the objection he had raised when the report of the Load Line Committee was in preparation as to the scantling requirements of ships of varying displacement. His own idea was that in vessels of small displacement lighter scantlings could be used than in vessels of higher displacement, but his colleagues did not agree. It was stated in the report that until it had been determined by actual experiments at sea the point raised must remain open to doubt. He was much interested therefore in the attempt being made by the author to show in a practical manner the nature of the stresses on ships at sea. The suggestions made by Professor Dalby on the subject of the instrument employed would, he hoped, receive careful consideration.

Mr. Lockwood Taylor, in reply, said that his apparatus had an order of accuracy down to about $^{1}/_{23}$ of a ton per square inch. He regarded the figures given as quite reliable within the limits of accuracy named. It was essential that an instrument of a simple character should be employed, and nothing more elaborate than that used in his experiments would suit the class of work in which he had been engaged. He was much interested in Mr. Ayre's references to the effect of hatch combings on the calculations. The paper showed the effects of buckling. The main point raised by Mr. Foster King was that of temperature variation, which had been dealt with to some extent in the paper. In any case, it was only the difference of temperature between the instrument and the structure for which allowance had to be made, and that was normally quite small.

The President accorded a vote of thanks to the author, which terminated the business proceedings.

Social Engagements and Visits to Works.

Chief place in the programme of social engagements and official visits must be accorded to the reception held by the King at the Palace of Laeken. It was of a formal character in so far as the object of the reception was to present the King of the Belgians with the diploma of honorary membership of the Institution, but it developed into a pleasant social gathering. The Duke of Northumberland, who was accompanied by the Duchess, made the formal presentation to the King, which was gracefully acknowledged. His Majesty and the royal party, which included the Queen, Prince Charles-Theodore, Prince Leopold, and Princess Marie Jose, thereafter mixed freely with members of the Institution, all of whom had the opportunity of engaging in conversation with the King, Queen, and the other members of the royal household. After tea had been served the party, under the personal guidance of the King and Queen, visited the famous Laeken greenhouse corridors, now a perfect blaze of colour, and the gardens and park. There was a delightful informality about the whole event which contributed very largely to the pleasure of those who took part in it.

Other engagements during the stay in Brussels were a reception by the civic authorities at the Hotel de Ville, where the priceless tapestries and other artistic and historic treasures were inspected; a visit to the University at Sollbosch; a reception and tea at Tervueren, given by the Société des Ingénieurs et des Industriels. On the last occasion Monsieur de le Paulle, President of the Society, welcomed the visitors in an eloquent address. An inspection of the wonderfully arranged Colonial Museum at this charming country retreat from Brussels was afterwards made. A performance at the Opera, on the same evening, for which invitations had been issued, was largely attended.

Leaving Brussels in the morning of June 24th, the party proceeded by road *viâ* Louvain and Malines to Antwerp. Louvain it, was gratifying to see, has made a wonderful recovery from the tragedy of the wanton destruction which took place during the war. Around the old town hall, which came back into Belgian possession undamaged, a new central section of the city has arisen, and good progress is being made with the rebuilding of the library. At Malines the cathedral was inspected and a carillon was given on the famous peal of bells by ringers from Antwerp, a kindly thought of the Executive Committee, one of the most active members of which, Major H. J. P. Béliard, had met the party at Louvain and acted as escort into Antwerp.

Three most interesting days were spent in the maritime capital of Belgium. On the evening of arrival a banquet was given at the Terminus Palace Hotel by the city authorities, Burgomaster F. van Cauwelaert presiding over a distinguished company. This initial hospitality was the first of a series of pleasant entertainments.

On the following day, June 25th, after the meeting for the reading and discussion of papers, the Antwerp Ship Repairers' Association, under the presidency of Mr. David Petrie, entertained members to luncheon at the Zoological Gardens Restaurant

The afternoon was devoted in the first place to a visit to the world-famous Plantin Museum. It was here, of course, that printing and engraving were developed from crude methods into processes having the qualities of beauty and commercial utility. Some specimens of the fine engraving work of the house of Plantin were reproduced on the programmes of some of the social functions attended. Place cards at table had borders composed of old engravings, and the typographical ornaments of the menu card at the final banquet were reproductions taken from the Plantin edition of 1574 and from work of even earlier dates. After the visit to the Plantin Museum, which is now the property of the city of Antwerp, members and their ladies attended a reception and tea given by Major and Madame Béliard. In the evening the Governor of the Province of Antwerp, Baron Holvoet, and Madame La Baronne Holvoet gave a dance at the Palais du Gouvernement Provincial, which was largely attended and much enjoyed.

Dock Extension Works.

Saturday, the last day of the stay in Antwerp, was devoted mainly to visits which possessed technical interest. The old dock system and the additions now in the making were inspected and the shops of the Antwerp Engineering Company and Béliard Crighton and Co. were visited. While it was all of interest, the docks being full of shipping and reflecting the growth of the traffic of the port and the ship-repairing industry being at work up to full capacity, the chief attraction perhaps was the new tidal entrance to the enlarged dock system.

This entrance lock, which is being built at Kruisschans, about 5 miles downstream from Antwerp, will have a length of 886ft., a width of 115ft., and a depth ranging from 33ft. at low tide to 47ft. at high water. The lock itself is now almost completed, the work being advanced to the stage when the Stoney roller gates, of which there will be a pair at each end, are going into position. No special difficulties have arisen in the construction, but provision had to be made by regular pumping operations for the discharge of water out of the foundations and at one or two points. The granite lock walls had to be carried down to a depth of 66ft. below low-water level. The work of construction has reached a stage which ought to enable the lock to be completed early in 1928.

Starting from the new lock is an extension of the Canal Dock, over 3 miles long and ranging in width from 1300ft. to 985ft. This canal will be connected to the existing docks by means of a junction channel 1312ft. long and 330ft. wide. One effect of these works is that the smaller waterways north of Antwerp have had to be diverted. The diversion is now completed. The Canal Dock works, which had suffered delay from various causes, have now been resumed and good progress is being made.

In the afternoon of Saturday last a reception was given by Mr. and Mrs. Petrie at Cappellenbosch.

Mr. David Petrie, who had on more than one occasion referred to the skill of Belgian craftsmen in hammered ironwork, created a pleasant surprise at the final banquet by presenting a handsome pedestal lamp to the Duke of Northumberland. Other examples of this fine work were presented by Mr. Petrie to Sir Archibald Denny and to Mr. R. W. Dana, the secretary of the Institution, who was a member of the Belgian Executive Committee and co-operated in arranging the excellent programme of the meeting.

The final function at Antwerp was a banquet given by the Institution to their Belgian hosts, when the Duke of Northumberland presided over the largest gathering of the week. The principal guests included Monsieur Baels, Minister of Public Works, representing the Government; Baron Holvoek, Governor of the Province of Antwerp; Monsieur F. van Cauwelaert, the Burgomaster of Antwerp; Monsieur Pierrard, Director of the Ministry of Marine; and Captain A. F. Carpenter, of H.M.S. Vindictive. Following the loyal toasts the Duke of Northumberland and Mr. Francis Henderson gave expression to the keen appreciation of members of the Institution of the work done by the Reception and Executive Committees in making the meeting the complete success that by general assent was attained.

Visit to Zeebrugge.

On Sunday the party left Antwerp by special boat for Dover, an early start being made to enable a call to be made at Zeebrugge, where it had been arranged that members of the Institution should be present at the ceremony of unveiling a tablet on the Mole to mark the spot where the Vindictive lay alongside during the raid. It was felt that permanent records should be made of this and the other spots at Zeebrugge which were vital to the operation of sealing the ports. The first tablet which was unveiled on Sunday by Prince Charles of Belgium, himself a British naval officer, records the bare facts; but Colonel Stinglhamber paid eloquent tribute to the gallantry of the daring exploit, and Captain Carpenter, who had accompanied the party from Antwerp, afterwards gave, at the Zeebrugge Museum, a simple but fascinating account of the raid. It was regarded as a privilege to hear on the spot where the exploit was performed his own modest story of one of the most stirring episodes of the Great War. It was a fitting termination to the Belgian meeting of the Institution.

THE Algoma steel works at Sault Ste. Marie, Ontario, are now working at full capacity and employ 2300 men.

A Contractors' Petrol Locomotive.

ONE of the chief difficulties experienced by the designers of small locomotives for hauling comparatively large loads at low speeds, in, for instance, such services as those of a civil engineering contractor, is, of course, the provision of sufficient adhesion between the driving wheels and the rails to prevent them slipping, and we have, in the past, described several schemes which have been developed for the purpose. A new idea of this kind has been perfected by J. and F. Howard, of Bedford, and we recently took the opportunity of inspecting and testing in service a narrow gauge engine of this type.

The locomotive—of which we give some photographic illustrations and line drawings—is of 2ft. gauge, and is driven by a 25 horse-power petrol engine. It weighs approximately 3½ tons. The chief peculiarity lies in the fact that, in addition to the four normal coupled driving wheels, the engine is provided with an auxiliary rubber-tired driving wheel, which may be engaged with a track lying between the ordinary railway metals. This extra wheel is always rotating when the locomotive is running, but naturally only comes into action wherever the central track is provided. For all general service on fairly level track the ordinary coupled driving wheels have ample adhesion on the rails to move the rated load of the engine, but where a steep gradient is encountered there is a liability for the wheels to slip. It is only necessary to arrange the central track, for the rubber-tired wheel, in such places. Then, when the locomotive runs on to such a section, the auxiliary wheel comes into action automatically and provides an extra adhesion amounting to some 50 per cent. of that available from the plain driving wheels. The central track, as we saw it in Messrs. Howard's trial ground, takes the form of a light wooden platform, a foot wide, bolted to the sleepers, but it is obvious that it might be built in several other ways, according to local conditions, as, for example, in concrete or hard road metal. In either case the cost of the track itself is an inconsiderable matter as compared with the advantage it offers.

The locomotive does not differ in general principle from accepted practice, but it embodies several peculiar features in detail, that are worthy of notice. Before going on to describe them, it may be as well to give some of the leading particulars.

The overall length of the engine is 10ft. 9in. and the width 3ft. 11in., while the height is 5ft. 4¾in.—if a cab is fitted over the driver's seat the loading gauge is slightly increased. The gauge is 2ft., the wheel base is 3ft. 11in., and the driving wheels are 1ft. 6in. in diameter. It is driven by a four-cylinder petrol engine of 25 brake horse-power with cylinders 95 mm. in bore by 140 mm. stroke. The engine normally runs at 1000 revolutions per minute, but can be speeded up to 1600 revolutions per minute, when it develops 33·3 brake horse-power. The engine is coupled directly with a two-speed gear-box, through a clutch, and the combination is mounted on a substantial framing, separate from the main frame of the locomotive, so that it can be removed bodily for overhauling if necessary.

The gear-box was specially designed for the purpose, and is illustrated by the line drawing—Fig. 2. It gives two speeds in either direction, but only one lever is necessary to change the gears. There are, of course, plenty of gear-boxes in which several speeds in one direction and a single reverse are manipulated by means of one lever, but in the case of the gear under review, both the speeds are available in either direction, and yet the mechanism is very simple.

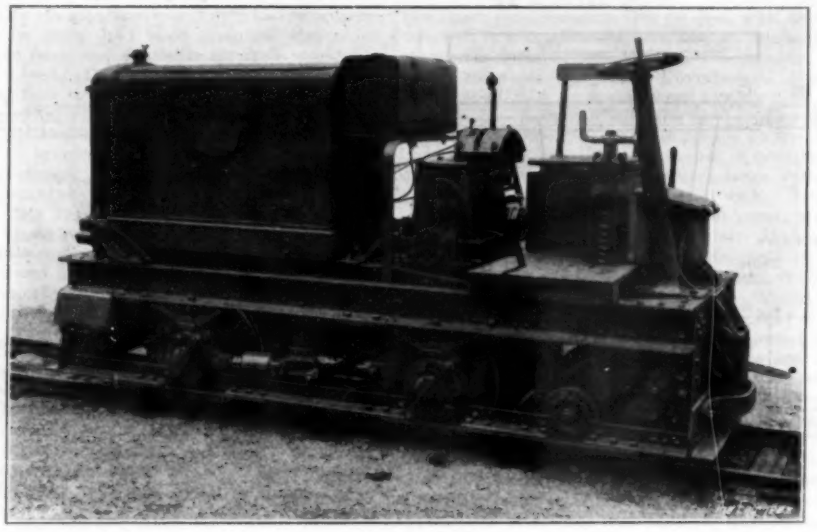


FIG. 1—CONTRACTORS' PETROL LOCOMOTIVE

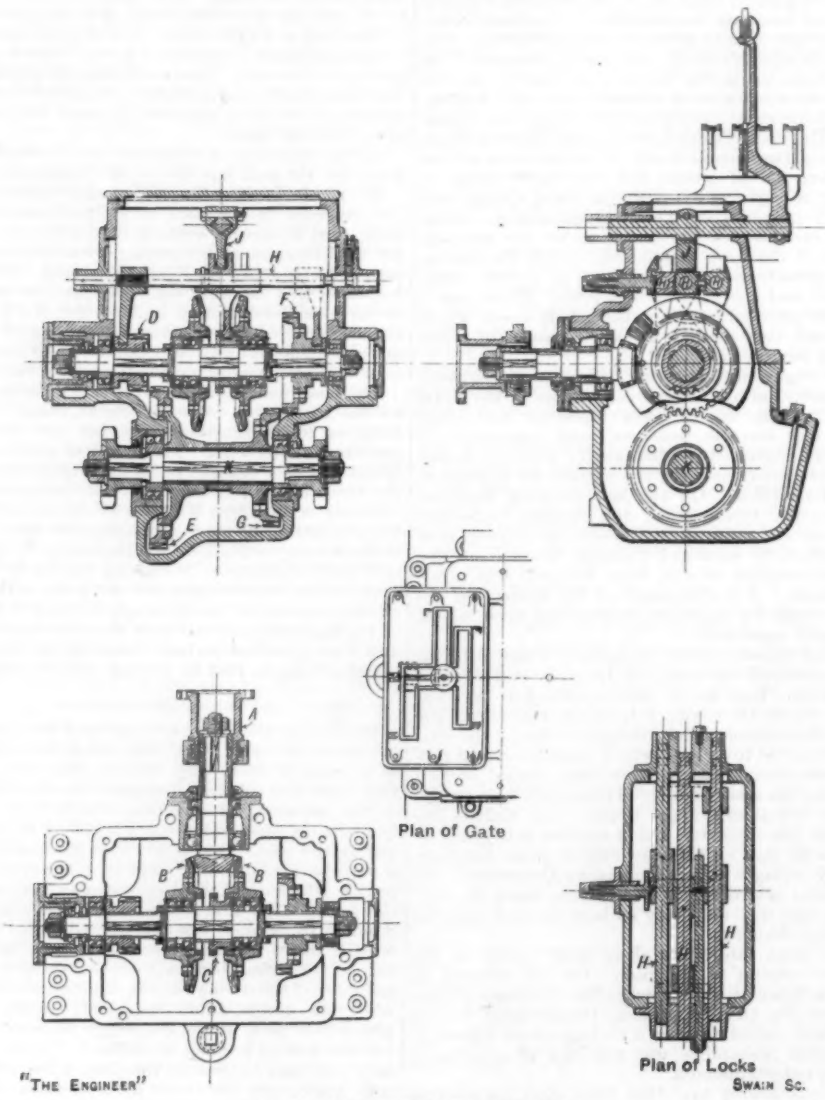


FIG. 2—ARRANGEMENT OF GEAR BOX

On reference to the sketch in the centre of Fig. 2, it will be noticed that the "gate" in which the change speed lever is worked is of rather unusual design. Thus there is one slot marked "forward" and "reverse," out of which the lever cannot be taken without first going into a transverse "neutral." Then either the low or the high gear can be engaged for either forward or reverse travelling. For effecting these changes there are two sliding gears and one dog clutch, either of which can be engaged by the change-speed lever.

In the sectional plan of Fig. 2 it will be seen that the driving shaft A is connected with a countershaft in the gear-box, by means of bevel wheels B B. These wheels are, however, free to rotate on the shaft, but either of them may be coupled therewith by means of the sliding dog clutch C. The two different speeds of travelling are provided for by the ratios of the gears D E and F G, which can both be slid into, or out of, engagement on their respective shafts. Thus, it will be seen, there are three parts—one dog clutch and two gear wheels—which must be moved in order to get the various gear combinations. These three parts are, in turn, manipulated by forks, depending from the guide rods H H H, any one of which may be engaged by the extension J of the change speed lever. The whole lever can be moved transversely, from one slot to another of the gate, and can, consequently, be used to manipulate any one of the forks. There is a system of locking catches, as illustrated by the sketch in Fig. 2, which insures that when any one of the gears has been engaged it will remain so until it is deliberately disengaged by the lever. From the second shaft K of the gear-box the power is transmitted to the front axle of the driving wheels by means of a pair of roller chains, as shown in the general arrangement—Fig. 4. The two main driving axles are coupled together by a separate chain and sprockets.

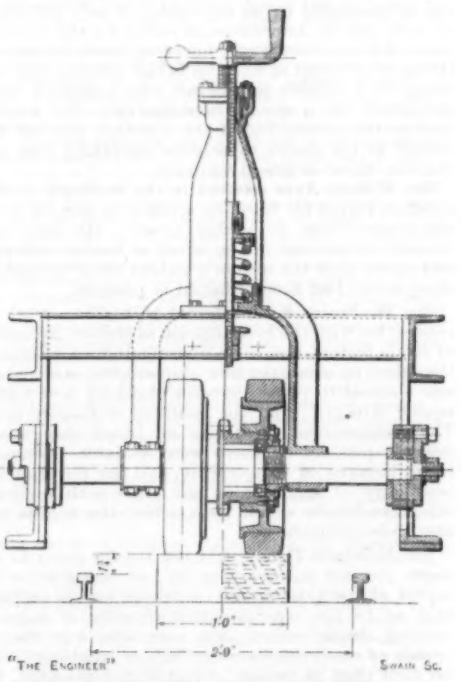


FIG. 3—CENTRAL WHEEL MOUNTING

In order to adjust the axles and maintain a proper tension in the chains, the axle bearings, which are of the roller type, are mounted in excentric housings—as shown in Fig. 6. The movable part of this housing, it will be seen, is held in place by a strap and two bolts, while it is prevented from rotating by a set screw. There are eight separate holes in the excentric for the set screw, and two holes, at a different pitch, in the fixed part. A fine adjustment is thus provided, and there is sufficient scope to take up one whole link of the chain. In order to prevent a sudden jar from putting an undue shock on the driving chains, the axle boxes of the leading wheels are free between the horn plates to the extent of about a ¼in. and short

radius rods are provided on either side. These rods are telescopic and include a powerful coiled spring for taking up the shock..

So far we have only referred to those parts of the locomotive concerned with the ordinary driving wheels, and now come to the auxiliary rubber-tired wheel which

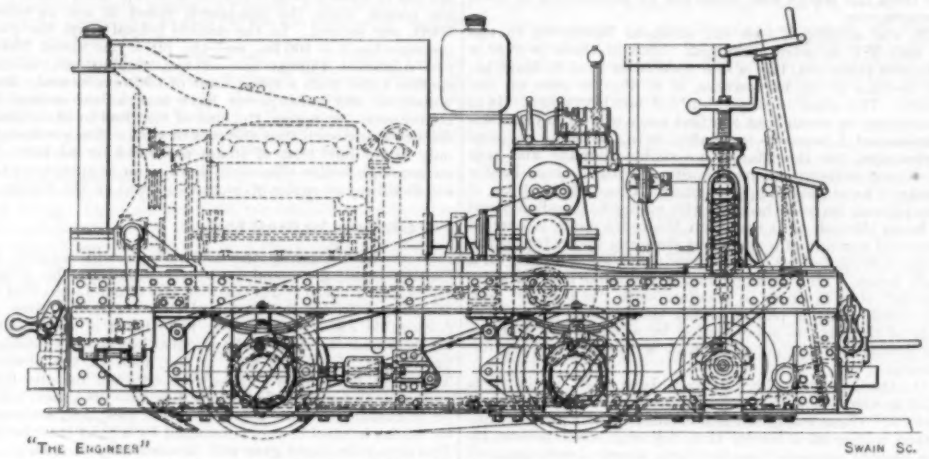


FIG. 4—GENERAL ARRANGEMENT OF LOCOMOTIVE

is at the rear of the engine, under the driver's seat, and is illustrated by the line drawing—Fig. 3. The wheel, it will be seen, is twinned, with a driving sprocket in the middle, by means of which it is driven off the rear axle by a chain. The wheel is 16in. in diameter, and the tires are each 3½in. wide. The wheel is provided with ball bearings, and is mounted on a fixed axle, which has excentric adjustments between the horn plates similar to those of the other axles. There is a cast steel yoke straddling the auxiliary wheel and fixed to the axle, above which a strong helical spring is arranged. This spring is in a column beside the driver, and is plainly shown in the half-tone engravings. A fine pitch screw is provided to put it under compression, and thus transfer part of the weight of the machine to the auxiliary wheel.

The remainder of the locomotive needs little comment, as it is of more or less normal design, but it is noteworthy that the tie bars beneath the horn plates are bolted in place, so that they can be readily taken off, and the wheels dropped if necessary, while the engine starting handle is arranged at the side for convenience when the locomotive is coupled up to a train.

One of the first characteristics of this locomotive which we noticed on getting it on the trial ground, was that,

FIG. 5—REAR VIEW

although the track was rather rough and rusty, one man could quite easily start it from rest and push it along the level—a feature which is to be accounted for by the generous adoption of ball and roller bearings. The engine was started up without any difficulty, and the locomotive was then coupled up to a number of tip wagons loaded with scrap iron, the wheels of which were spragged. In the coupling there was a hydraulic dynamometer. By letting the engine clutch in gradually it was possible to increase the tractive effort until the driving wheels slipped on the rails and the readings of the dynanmometer thus obtained were taken as the draw bar pull of the locomotive. In these circumstances it was rather difficult to judge the pull with the fast gear in action, as the slack in the couplings was taken up so suddenly that the jerk made the wheels slip. With the low gear engaged the results were, however, much more consistent and are really a better guide as to the hauling capacity of the locomotive. In this way we found that the four steel-tired wheels gave a tractive effort of 2000 lb., and that with the rubber-tired wheel in action it was increased to as much as 3000 lb. At this load the auxiliary wheel began to slip, but the slipping did not appear to damage either the tire or the wooden track to any great extent. It is obvious, however, that such slipping, if the driver persisted, would be injurious, but it is so palpable that he would be warned to free his clutch.

As a test of the ability of the mechanism to stand up against the rough handling of an inexperienced driver, we started it at the bottom of a rising gradient, with a full load, by letting in the clutch abruptly. The driving wheels naturally slipped somewhat, but on each of several occasions the engine got away with the load and mounted the rise. Another test was to run it as fast as it would go, which we judged to be 18 miles or so an hour, from a piece of plain rail track on to a section provided with the central wooden track, and with the auxiliary wheel screwed hard down—in fact, harder down than the makers recommended. In this case, also, the engine ran quite nicely and took the bump of the change without any tremor.

We were not able to test the whole range of the hauling capacity of the locomotive, but found that it would quite readily take a load of 10 tons up a gradient of 1 in 19, while

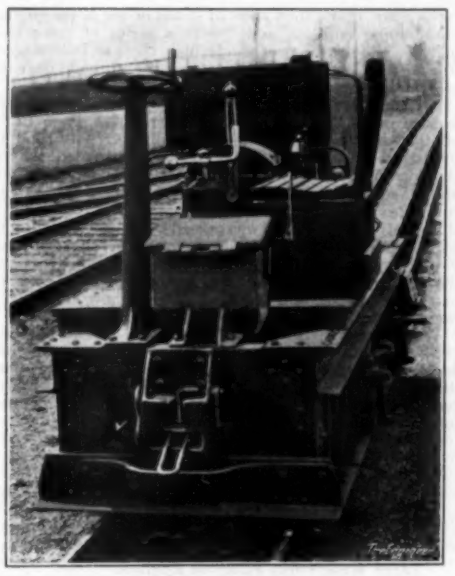


FIG. 7—FRONT VIEW

Messrs. Howard assure us that it will haul 35 tons on the level in the fast gear on the plain wheels, or 85 tons with the low gear and the auxiliary wheel. The two speeds, with the engine running at 1000 revolutions per minute, are 3·16 and 8·15 miles per hour, but, as we have already mentioned, the engine can be speeded up considerably beyond these limits. Taken altogether the engine is a decidedly substantial machine, and is one of the most workmanlike jobs of its kind which we have seen for some time. The makers are, by the way, prepared to supply the locomotive without the auxiliary wheel if it is not required.

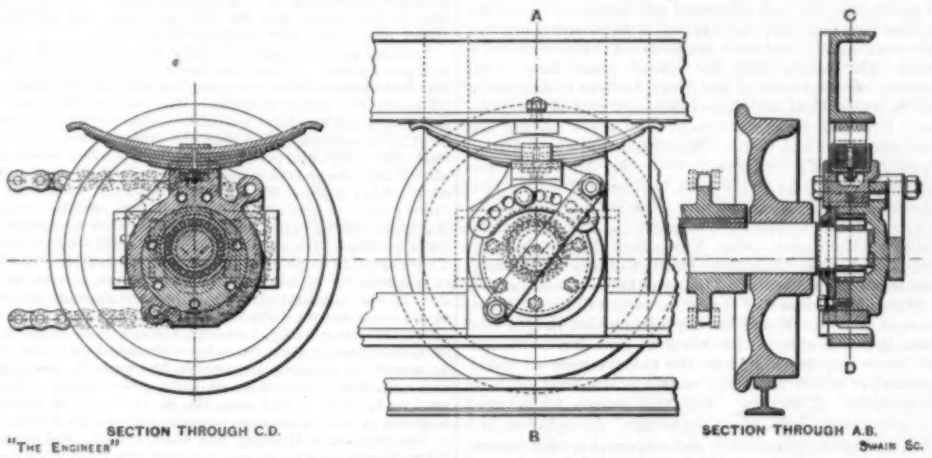


FIG. 6—ARRANGEMENT OF AXLE BEARINGS

Sixty Years Ago.

It is always of considerable interest to survey the prophecies of a former period and to note how time has confounded or confirmed them. It is an occupation, too, which the prophets of to-day might pursue more frequently than they do in order to acquire caution in their efforts to forecast the future. In our issue of June 29th, 1866, we find one or two instances of prophecy which are worthy of note in the light of our knowledge of what has come actually to pass. In those days, as we stated last week, considerable apprehension had begun to be expressed regarding the exhaustion of our coal resources, and in the United States some people were already anticipating the day when, Great Britain's coal having been worked out, the centre of gravity of the world's manufacturing activity would move across the Atlantic. A Royal Commission, under the chairmanship of the Duke of Argyll, was about to be appointed to inquire into the extent and mode of working of our coal fields. Meanwhile the prophets were busy. One of them, a Mr. Hull, estimated that only 83,000,000,000 tons of coal remained to be mined within a depth of 4000ft. The use of the word "only" seems a little difficult to understand, for at the current rate of production the figure named indicated a reserve sufficient for between 800 and 900 years. Making allowance for an increase in the annual consumption of coal, another prophet, Mr. Jevons, calculated that at the then rate of progress a little over a century would see our coal fields exhausted to a depth of 4000ft., or 1500ft. deeper than the deepest mine then in existence. Mr. Jevons took the rate of increase at 3½ per cent. per annum, and for the year 1921 estimated the output at 658,000,000 tons. Actually the year 1921 showed an output of some 163,000,000 tons, but production was stopped for eighty-eight days by the coal dispute. The average of the 1920 and 1922 productions was just over 240,000,000 tons, or little more than a third of the prophesied figure. An enlightened prophecy in another field was reported in the same issue in our account of a paper read by Mr. Wenham before the then newly formed Aeronautical Society of Great Britain. Mr. Wenham stated that from 3 to 4 horse-power was required to raise 100 lb. in the air by means of a screw or windmill rotating with its axis set vertically. He concluded that any machine made on this principle must end in failure. Although Mr. Wenham's prophecy has been substantiated by the repeated failure to construct and fly a practical helicopter, we cannot give him as much credit for it as we would like to do, for it was based on the assumption that no continuous source of motive power was available which was sufficiently light even to support its own weight. The Lenoir gas engine was at that date being developed, but the implication of the internal combustion principle was apparently not appreciated. Mr. Wenham could not foresee an engine weighing less than 33 lb. per horse-power. A modern air-cooled aero engine weighs less than 2 lb. per horse-power. In another connection we must number ourselves among the false prophets. Following repeated remonstrances in Parliament and the Press, the Admiralty had at last conceded increased allowances to certain classes of engineers in the Royal Navy. The increases were, however, confined to the occupants of the higher berths and could not be accepted in satisfaction of other just demands. Our false prophecy lay in our assertion that the next great naval war would really open the eyes of the Admiralty to the true importance of its engineers. The years 1914–1918 have come and gone. Even yet there is no sure evidence that My Lords understand "that the engineers of a war vessel must be men of science and practice, full of all the resources and coolness in danger upon which depend the safety of the whole vessel and the success of its operations."

On page 673 of our issue of December 18th last we mentioned that a prize of £500 had been offered by the London and North-Eastern Railway for some arrangement that would dispense with the "hanging buffers" at present necessary for wagons operating on the inclined planes on the North-Eastern section of the line. As yet no satisfactory solution for that problem has been forthcoming.

Obituary.

MR. CHARLES MARKHAM.

THE death of Mr. Charles Markham occurred suddenly at his home, Ringwood Hall, near Chesterfield, on Tuesday, June 29th, from heart failure. His health had for some time past occasioned anxiety, and he had but recently returned from a voyage to South Africa, undertaken on the advice of his doctor. He was sixty-one years of age.

Charles Paxton Markham was a man of marked and virile personality. He was an engineer of exceptional ability, a brilliant organiser, and had a mind specially qualified to seize upon the essentials of a problem, and to discard all extraneous considerations. He enjoyed, moreover, a reputation for fearless and independent thought and action, for honesty of purpose, and for a sense of fair-play. One of the largest employers of labour in the country, he had in an unusual degree both sympathy and understanding for his employees, by whom he was trusted because he never failed them. He possessed, moreover, the respect and admiration of his staff. Direct, impetuous and forceful, he was just and fair-minded. His benefactions were numerous, but they were always made with forethought and were of the kind to strengthen and confirm rather than to sap the self-reliance of the recipients. He was an advocate of profit-sharing in the sense of making his workmen the actual partners of his enterprises; they were encouraged and helped, substantially, to become shareholders in the many undertakings in which he had an interest.

Mr. Markham was the eldest son of the late Mr. Charles Markham, of Tapton House, Chesterfield, and a grandson of Sir Joseph Paxton, the famous designer of the Crystal Palace and of the gardens of Chatsworth. He was educated privately, and from his earliest manhood devoted himself to the development of the iron, steel, coal and engineering industries with which his family had for many years been connected. At the time of his death he was chairman of the Staveley Coal and Iron Company and of the Park Gate Iron and Steel Company, the former having last year absorbed the firm of Markham and Co.; Broad Oaks Ironworks, of which, too, Mr. Markham was formerly chairman. He had besides extensive coal interests. He was managing director of the Brodsworth Main Colliery Company; the Newstead Colliery Company, the Yorkshire Main Colliery, Ltd., and the Bullcroft Main Colliery Company, besides being a director of many other coal companies.

His independence of character could ill brook interference or control, and his experience had taught him that direct dealings with his own men led to results far more satisfactory than the intervention of intermediaries, either from the ranks of the men or from associations of owners. For this reason he severed his connection with the Coalowners' Association last year and took, with gratifying success, his own course. He had done much to develop the coal resources of the South Yorkshire coalfield; he knew his men, and he knew the problems involved. In the circumstances he displayed the preference which had guided him all his life, for managing his own affairs in his own way. On the other hand, Mr. Markham, although a strenuous and indefatigable worker himself, interfered but little with his own subordinates. He had a flair for ability in others, and he knew, too, the value of a sense of responsibility. Hence, when he delegated work he delegated generously, and having surrounded himself with men of marked ability, it may be said that his methods in this respect were invariably successful. The men he has left behind him are, for the most part, the men he had trained himself. They will maintain the traditions he has left, but they cannot fill the gap in industry which his death has created. The times are such that men of his type are rare, and their loss is a real loss to the country at large.

The Newcomen Society.

THE largeness of interests which characterises the Newcomen Society is always shown in its summer meetings. It was established a few years ago with the purpose of studying the History of Engineering and Technology, and, although engineering occupies, perhaps, the greater part of its attention, it never forgets that all branches of technology are within its scope. Hence it is that for its summer meetings it selects places where remains are to be found, not only of the engineering of the past, but of other industries which possess a technological history.

Last week Norwich was visited, and naturally, when one remembers their prevalence at one time in East Anglia, windmills received a great share of attention. The first to be visited was one in the possession of Mr. R. Waters at Stokesby. It is still used for drainage, but, unfortunately, was not at work at the time. It operates a scoop wheel which is nothing more than a paddle wheel with blades which are long radially, but only a few inches, eight or nine, axially. The blades pass through a trough, but it has been found unnecessary to make them fit with any exactness. From Stokesby the tour was continued to West Somerton, where two grasshopper pumping engines were seen by the courtesy of the Winterton and Somerton Drainage Commission. Here also a windmill which drives a turbine pump was inspected.

The next point on the tour was Lound, where a call was made at the works of the Lowestoft Water and Gas Company. Here also there are grasshopper engines, and steam had been got up so that one of them might be seen running. It was, however, only working light, for it was uncoupled from the three-throw pumps. An interesting feature of the plant is that the three-throw crank shafts for the pumps are iron castings. A tower windmill not far from the works was inspected by permission of Lord Somerleyton.

In the afternoon two old dredgers belonging to the L. and N.E.R. were examined. One of them is over a hundred years old, but is still used from time to time, as, on account of its narrowness, it is able to pass up the rivers. The other is larger, but not much younger. It is interesting to recall that the first sank when the Germans bombarded Lowestoft—probably owing to some peculiar concussion, for it suffered no visible damage and was reclaimed without much difficulty. Both of these ladder dredgers have grasshopper engines. Those of No. 1 are of exceptional interest because the connecting-rod, instead of being jointed, as is usual, on the beam itself, is carried from the summit of a short rod standing up on top of the beam and guided by a pair of swinging links hinged on a deck beam. This arrangement is rendered necessary by the fact that in order to accommodate the train of gear the crank shaft is placed higher than usual. The valve gear of this engine is controlled by a single gab and the manipulation of this gear was witnessed with great interest.

On the following day, Friday, June 25th, a visit was paid to the silk weaving works of Messrs. James Arnold and Co. These works are maintained in their present condition rather as a hobby than for any other reason, by the present owners—two brothers, direct descendants of the original owner. With the exception of a tiny gas engine which winds the bobbins, no power is used in the little factory. All the looms, which remain in their original condition, are operated by hand and foot, and most of them were busy, for we were glad to hear that there is no difficulty in getting orders enough to keep them engaged. Some of the looms were on plain work, pugarees, &c., whilst others were working fancy patterns with Jacquard cards. Norwich claims to have introduced the designs which are so familiar on Paisley shawls, and that pattern is largely made at Messrs. Arnold's factory. The workmanship is admirable and has that peculiar and indefinable charm associated with hand-made products.

Leaving the silk works, a very fine example of a post-mill was visited. It was Harrison's mill in Sprowston-road, and fortunately there was enough wind to revolve the sails, although but intermittently. The mill is still used for grinding grain and has two pairs of stones. The timbering of it is exceptionally fine, but the most notable feature is that the revolving part, that is to say, the whole mill above the round-house, is carried on a ball race. This race, which is some 3ft. or so in diameter, surrounds the main post. It consists of two cast iron circular troughs, the lower one in two parts, which are filled with cast iron balls, perhaps 2½in. in diameter. The balls are not turned. There appears to be little doubt that the ball race has been in position for at least one hundred years, but so far the date of the building of the mill has not been ascertained, and it is not known if the ball race was there from the beginning. It seems likely, however, for since one of the races is in one piece it must have been threaded on to the post. It would be possible to remove the post by jacking up the mill, but it would be no light undertaking. We are glad to be able to add that Mr. H. O. Clark, of Norwich, is going to make complete measured drawings of this mill.

The Bridewell Museum was then visited, and amongst other things seen there was the first practical machine for making wire netting. It has all the characteristics of modern machines, which differ from it but little in general design.

Two evenings were given up to lectures—and very admirable lectures they were. Mr. H. O. Clark gave the first, his subject being "Ancient Local Industries." With the help of a splendid series of slides he explained the whole method of mining flints and of then reducing them for use in gun locks or squaring them for the facing of buildings as may be seen in many houses and churches in Norfolk. The industry is fast dying out, but millions of gun flints are still sent to Africa for the weapons of native races. Mr. Clark then showed slides of big horse engines, grasshopper engines, and finally a series of remarkable pictures and drawings of windmills. He is an indefatigable worker and has actually measured up and made drawings of some of the things he exhibited on the screen.

On Thursday evening Mr. Walter Rudd gave a charming lecture on "The Strangers in Norwich, a Page in the History of our Ancient Textile Industry." It took the industrial rather than the technical view and dealt with the introduction of the Dootchmen—probably Walloons and Flemings—into East Anglia and the impetus they gave to the textile industry in Norwich. At the conclusion of this meeting a resolution was passed by the Society supporting Mr. H. O. Clark in his efforts to persuade the Norfolk and Norwich Archæological Society to adopt and preserve a windmill. A movement of this kind appears to be on foot in several places, and we need not say how sincerely we hope it may succeed and spread.

We must not forget to say in conclusion that on Thursday the Lord Mayor (Mr. Thomas Glover, M. Inst. C.E.) and Lady Mayoress were the principal guests at the annual dinner, and that on Friday morning the Lord Mayor received the Society at the Guildhall. Altogether it was a most successful and delightful gathering.

American Engineering News.

Large Waterworks Pumping Engines.

For the new Western-avenue pumping station of the Chicago waterworks, four geared centrifugal pumps with compound steam turbines, giving a total capacity of 300 million gallons daily against a head of 110ft. to 150ft., were adopted. This type was decided upon after careful consideration, as showing the lowest overall operating costs for large stations working against comparatively high heads. Diesel oil engines would be very costly, and with their low speeds would require four stages of geared pumps to develop the required head. Triple-expansion engines are the most economical in steam consumption, but their maximum size is about 50 million gallons daily, so that six units would be needed, while the first cost would be about three times as great. The horizontal shaft turbines are designed for 300 lb. gauge pressure, and a total temperature of 631 deg. Fah. at the throttle. They are not to exceed 5500 revolutions at full rated capacity of the pump, while the peripheral speed is not to exceed 900ft. per second. In the double helical gears the tooth pressure limit is 400 lb., and the pitch line speed 7500ft. per minute. Pumps are of the single-stage, double-suction type, with a speed limit of 600 revolutions. Four boilers of 600 horse-power have mechanical stokers for bituminous screenings, the cost of this fuel in the Chicago district being such that the cost of steam thus produced is only about half that of steam produced by oil fuel. To ensure high boiler efficiency there is an evaporator plant for distilling all make-up water supplied to the boilers.

Lift Gates for Canal Lock.

In designing the lock which will connect the Chicago drainage canal with a channel to the Illinois River, for a barge route between the Great Lakes and the Mississippi River, it was found that conditions were unfavourable for walls to resist the thrust of mitre gates, while it was desirable to have gates less liable to damage by vessels, since this lock is the head of the channel. Therefore, while mitre gates were adopted for the lower end, the upper end of the lock has two lift gates, which lie in chambers below the floor of the lock, and are raised by cables in steel towers connected by a light steel bridge. The upper or guard gate will be used only in emergency, the second gate being the regular locking gate. The gates are balanced by concrete counterweights. As the 110ft. width is too great for plate girder construction, each gate has five horizontal trusses, 6ft. apart, with buckle plate facing on the up-stream side. For the Ohio River locks the Government uses gates which move laterally, rolling into long narrow chambers at right angles to the lock, but that type would have required an excessive amount of concrete wall construction. In addition, the lift gate can be raised for inspection at any time, and can be repaired in that position. The gate weighs about 200 tons, as compared with 130 tons for the pair of mitre gates. Each bottom corner of the gate is fitted with a vertical buffer, consisting of a hollow steel plunger with spring, fitted into a cylindrical casting, the plunger being faced with an oak block.

A High Capacity Water Tank.

To meet conditions of very irregular demand for water, owing to one-third of the supply being used by manufacturing plants, the city of Charleston has installed a steel tank with an elliptical self-supporting bottom, which is said to be the largest tank of its type ever built. The tank is 80ft. in diameter and 35ft. deep in the cylindrical portion, while the bottom is 25½ft. deep and 54½ft. above the ground. A central riser pipe, 14ft. in diameter, contains the supply and discharge pipes. There is no roof, and instead of an overflow pipe, the overflow runs over the rim into a circular trough with a 12in. pipe to the ground. This trough, 18in. by 18in., also forms a stiffening ring girder. The tank plates are ⅜in. to ½in. thick, and ¾in. for the bottom. The supporting tower consists of twenty-four steel columns of H section, with the inner flange riveted to the tank plating, while the outer flange has a bracket for a circular balcony 24in. wide. Ring struts divide the height into six bays, with diagonal bracing in each bay. The total weight of steel is 675 tons, while the water load is 8550 tons. The central foundation, under the riser pipe, is designed to carry 16 per cent. of the combined load. The remainder of the load, plus a wind load of 100 miles per hour, is carried by the footings of the tower columns. All the tank steel is of the copper content type. To prevent corrosion, the interior was given a coat of hot bitumastic enamel, while all exterior surfaces were given two coats of red lead and a finishing coat of aluminium paint.

Waste Heat Boilers.

The successful use of fire-tube waste heat boilers in American steel mills has attracted attention to their use in other plants for the recovery of heat from waste gases of comparatively low temperature. But experience indicates that many accepted rules of boiler design for direct firing do not apply in this indirect firing. Rapid circulation of water is not essential, but the maximum heat recovery must be effected by conduction and convection. In the Melrose Park plant, near Chicago, a marked improvement in open-hearth furnace performance resulted from the better draught caused by the waste heat boilers, the furnace output being increased by about 20 per cent. Heat contained in the steam delivered from the superheater represented 39.2 per cent. of the heat value of the furnace fuel; the fan used 2.8 per cent. of the boiler output. In addition to the saving, the life of the regenerators is much longer than when dependent upon natural draught. Vertical boilers are used in some cases, but several plants use horizontal boilers with 2in. or 2½in. tubes 18ft. to 20ft. long. In the Fairfield works the four horizontal boilers are arranged for two passes, the second pass being used as an economiser element. Each boiler has 5000 square feet of water heating surface, and carries 250 lb. pressure. It is thought that waste heat boilers might be applied to advantage at cement works, where kilns producing sufficient clinker for 1000 barrels of cement in twenty-four hours yield about 83,000 lb. of waste gas per hour at about 1100 deg. Fah., or nearly equivalent to 350 net boiler horse-power per kiln. Internal combustion engines may also deliver their exhaust gases to waste heat boilers.

A START has now been made on the reconstruction of Wimbledon Station. The first step to be taken has been to throw out of use a siding and one passenger bay line on the north side of the station used by the Metropolitan District trains. Thereon an island platform is to be built and two bay roads laid for the use of District trains.

Railway Matters.

THE Railway Rates Tribunal was engaged last week in hearing complaints that the proposed new schedule of rates of the Southern Railway made no provision for coal-owners furnishing their own wagons; the charges provided only for company's wagons for the conveyance of coal and coke and Class 1 to 4.

THE Metropolitan Railway Company's Bill for the construction of a tube railway between Willesden Green and Edgware-road has passed the Committee stage. The Bill of the Southern Railway which, *inter alia*, provides for new curves that will permit useful through-running has been read a third time in the Commons.

IT is a year since any change was made in the railwaymen's pay owing to a rise or fall of 5 per cent. in the cost of living. On June 1st, 1925, the official index figure was 72 points above the July, 1914, cost. As on June 1st it was 67 points there will be a reduction of 1s. per week from July 1st. Not all railwaymen are affected, as about 50 per cent. reached the agreed minimum some time ago.

THE New York Central Railroad celebrated on April 17th the centenary of the granting of the charter for the construction of the Mohawk and Hudson Railway between Albany and Schenectady. The line was opened on August 9th, 1831, when the train was drawn by the De Witt Clinton. The Quincy Railroad, in Massachusetts, was an earlier road, but was horse-drawn; the Mohawk and Hudson was the first steam railway.

CANNON-STREET Station was reopened, after rearrangement of the tracks, on Monday last, and until July 11th a modified electrical service of trains is being operated. For some days last week trial runs were made so as to educate trainmen and signalmen in the new movements. In our issue of June 11th we announced that the numbering of the platform roads in Cannon-street had been rearranged and they now read from east to west. Charing Cross Station has also been renumbered.

THE accident bulletin for the year 1925 of the United States Inter-State Commerce Commission shows how one accident will completely spoil an otherwise good annual record. For 1924 the number of passengers killed in train accidents was the lowest up to that time—forty-one. Last year the figure was eighty-three, but, were it not for a derailment, as a result of a cloudburst, in New Jersey on June 16th, the total would have been only thirty-eight. The number of servants killed in train accidents was 232, as compared with 216 in 1924.

THE announcement of the death, on June 20th, of Mr. H. E. Jones affords us an opportunity to remark that in his former position of locomotive, carriage and wagon superintendent of the Cambrian Railway, Mr. Jones did some uncommonly good work, considering the somewhat limited resources he had at his disposal. He was the son of a director of the Midland Railway and brother to Mr. "Sam" Johnson's southern area running superintendent. Before going to the Cambrian he was the Midland Company's district locomotive superintendent at Belle Vue, Manchester.

THE Ministry of Transport railway statistics for February show that, compared with February, 1925, there was a decrease of 5·25 per cent. in the number of passenger journeys at full fares and of 2·56 per cent. in workmen's tickets, but journeys at cheap fares increased 58·06 per cent. The receipts from full fares fell by 5·21 per cent. and those from workmen by 2·98 per cent.; cheap fares increased by 32·47 per cent. Goods tonnage was 2·47 per cent. down and the receipts 2·44 per cent. The passenger engine mileage was reduced by 1·48 per cent. and the goods engine mileage by 1·27 per cent.

THE State ownership of railways has had another blow; the railways of Belgium, like those of Germany, are to revert to private ownership. A company is to be formed which is to be known as the Société Nationale des Chemins de Fer Belges. It will raise two thousand million francs in shares on the security of the railroads, out of which eighteen hundred millions will be repaid to the Treasury when due on December 1st. The Brussels correspondent of *The Times*, in announcing the above, says that three thousand temporary railway servants will be discharged and the regular men will have to retire on pension when sixty years of age instead of at sixty-five.

A RAILWAYMAN has recently been the cause of the House of Lords giving a judgment that differentiates "pay" and "salary." It was in the case of Druce *v.* The Railway Clearing House. The plaintiff was a member of the R.C.H. staff who had served with the Colours and who sued for payment of the war bonuses given to those who remained at home. In the case of Sutton, a Post Office telegraphist, the agreement was to pay to the Post Office men who joined the Colours four-fifths of their "full civil pay"; with the Clearing House it was four-fifths of their "salary." The House of Lords, in Sutton's case, decided by five votes to four that "pay" included all that a man received and therefore covered bonuses, but the present judgment lays down that "salary" does not carry bonuses.

AT the annual meeting of the Tramways and Light Railways Association, which was held at Torquay last week, the chairman, in reviewing the work of the year, said that the whole Council had waited upon the Minister of Transport in order to lay before him personally the serious consequences of the ever-growing competition of omnibuses with tramways. The Council had urged the necessity for action by the Ministry, and submitted that both on the grounds of benefit to the public and in the financial interests of the tramway undertakings, legislation should be introduced forthwith in order to place the matter on a more equitable basis. The Minister had appeared to sympathise with the Council's views in many respects, but pleaded that, owing to pressure on the time of the Government, he was unable to make any definite promise to submit new legislation. Only recently, the chairman continued, the Council had brought to its notice the case of one of the Association's members, a Lanarkshire company, an undertaking which had now suffered in one year a net loss of £9000, following upon a net profit the previous year of £48,000, this serious financial reverse arising entirely from the unrestricted competition of omnibuses.

Notes and Memoranda.

TESTS of welded connections made in connection with the construction of a steel-framed building in Canton, Ohio, indicate that two linear inches of $\frac{5}{16}$in. welding bead equals the shearing strength of a $\frac{3}{4}$in. rivet.

TESTS made by the Mining Laboratory at Fangtze in Shantung Province of China to distil oil from coal have proved very successful. From 1 ton of coal 25 gallons of crude oil have been obtained, of which 60 per cent. is pure kerosene, 30 per cent. tar, and 10 per cent. water.

A NOTE in *Nature* points out that the "F" steel, which was recently greeted in the daily Press as a Swiss invention, is nothing more than silicon steel containing from 0.67 to 1.1 of silicon and 0.1 to 0.14 of carbon. Steel of much the same composition was used in the construction of the Mauretania and Lusitania, and was the result of the original investigations of Sir Robert Hadfield.

A RATHER unusual type of explosion is detailed in one of the recent official boiler explosion reports. It was that of the cylinder casting of an overtype steam lorry which broke away from the saddle on the boiler. It is suggested that a slight crack may have been started in the casting, through rough usage in service, which in due course increased until the normal steam pressure completed the fracture.

ACCORDING to latest reports, there are more than 200 motor cars and 20 motor cycles in Kalgan. The former are in operation along the following routes:—(*a*) Kalgan–Urga, 800 miles; (*b*) Kalgan–Dolonor (Lama Miao), 200 miles; (*c*) Paotowchen-Ninghsia, 400 miles; (*d*) Kalgan–Pingtichuan, 170 miles; (*e*) Pingtichuan–Pangkiang, 250 miles. Roads planned for construction are (*a*) Ninghsia–Lanchow, Lanchow–Yenanfu, and Kalgan–Jehol.

AN article in the *Engineering News-Record* gives details of the increase in strength which may be imparted to concrete by impregnating it with molten sulphur. The tensile strength is, apparently increased from six to tenfold, while the strength under compression is about nine times as great as that of plain concrete. Some large electrolytic cells, made of this material, used at Niagara Falls, have withstood the corrosive action of hot ferrous and ferric chloride solution for over a year without damage.

SOME experiments carried out by the Industrial Fatigue Research Board on the cooling power of air in cotton weaving sheds equipped with fans, indicate that the increased air movement produced by the fans had no significant effect upon the number of warp breakages on the looms in their immediate vicinity. There were indications that the output on the looms affected by the fans was somewhat higher on the days when the fans were running. The highest output was obtained when the temperature was from 72.5 deg. to 75 deg., and the relative humidity 75 to 80 per cent.

IN the course of an investigation of requirements of refractories for the open-hearth steel furnace, metallurgists of the American Bureau of Mines have measured temperatures in several open-hearth furnaces in the Pittsburgh district. Fundamental data were obtained on the condition necessary for accurate measurements of temperature, a subject which has become of increasing interest in control of steel making and prevention of overheating of the refractories used in the roof and walls. It was found that near the end of the heat, at the high temperatures employed, the temperature is practically uniform throughout the melting chamber. Temperature measurements through refractory walls showed that at steel-making temperatures—2700–3000 deg. Fah.—thick, insulated walls have practically the same inside surface temperatures as thin, air-cooled or water-cooled walls in the same furnace. An insulated wall can, however, be overheated and fused more easily, owing to less heat losses and flatter temperature gradients through the wall section.

A MESSAGE received from Paris states that at a meeting of the Fuel Utilisation Section of the Scientific Petroleum Committee, a report was read by Monsieur Dumanois, head of the technical services of the National Liquid Fuel Office, on the results of his work on anti-detonants. Monsieur Dumanois stated that, since 1913, he had been studying detonation phenomena in engines and the means of abolishing them. He held that the theoretical study of the explosive wave led to the conclusion that, to gain the end in view, it was necessary to destroy on the front of the wave the coincidence between a physical phenomenon and a chemical phenomenon. After having dealt with the chemical phenomenon by so-called anti-detonation bodies, which he showed were only ignition-retarding agents, Monsieur Dumanois argued that he could arrive at the same result by acting on the physical phenomenon. Accordingly, he invented a new form of piston with steps arranged in the direction of the propagation which, by the sudden enlargement of section which they produced, destroyed the wave as it was formed.

AS a result of recent experiments made to test the strength of the welded steel tube, for the Mokelumne River water supply project, in the United States, it has been decided, according to the *Iron and Coal Trades Review*, to rivet the circular joints hereafter, but to weld the longitudinal joints. The test involved a section 3600ft. long, in 120 sections of 30ft. each, 65in. in diameter. All joints were welded, the longitudinal seams being welded by the Lincoln automatic arc-welding process. The circular joints were welded on the outside by the acetylene torch, and on the inside by the hand-arc welding process. A pressure of 197 lb. to the square inch was applied, and a careful examination failed to reveal any leaks. After considering all records and tests, the board of engineers, concluded that, while the longitudinal joint-welding was entirely satisfactory, the circular welds would be more satisfactory if riveted, on account of the imprisoned stresses shown by the experience of welding. The welding experience showed that the imprisoned stresses were mostly in the upper part of the tube near the top, and as an added precaution, it has been decided to weld steel strips upon the part of the welded tube in place to resist any tendency to rupture in the future. The tube ranges from 63in. to 66in. in diameter.

Miscellanea.

A LARGE factory for the manufacture of chemicals and drugs is to be put up at Shanghai.

A NEW newsprint paper mill is to be added to the plant at Bromptonville, Quebec, and will bring the output of the factory up to 220 tons a day.

A FACTORY has been set up by the Government of Bihar and Orissa, at Patna, for developing the match industry on proper scientific and technical lines.

THE value of the mineral production in British Columbia made a new high mark in 1925, when the output totalled 61,492,242 dollars, as against 48,704,604 dollars in 1924 an increase of 26·2 per cent.

THE Manchester section of the Society of Chemical Industry, with the assistance of Provincial Exhibitions, Ltd., proposes to hold a national Exhibition from November 16th to 27th, in Manchester at the City Exhibition Hall, covering coal products, chemical products and chemical engineering.

POWER transmission wires have been installed between the mainland of Canada, the Beaupré Coast, and the island of Orleans by the Montmorency Electric Company, which will be the first company to supply electricity for lighting purposes on the island. The company is developing falls on the Ste. Anne River, and has come to an agreement with the Shawinigan Water and Power Company to meet its needs.

WITH the assistance of the Carnegie United Kingdom Trust the Association of Special Libraries and Information Bureaux has undertaken, as one of its first activities, the compilation of a Directory of sources of specialised information in Great Britain and Ireland. The general editorship of this important work has been entrusted to Mr. G. F. Barwick, late Keeper of Printed Books at the British Museum.

IT is reported from Buenos Aires that Congressional approval has been given for the initiation of the large public works programme in the Argentine already approved, for which 51,500,000 (paper) pesos have been allotted. Among the works to be undertaken are the construction of a number of new roads and road bridges—6,000,000 pesos—irrigation works—6,500,000 pesos—port improvements and navigation—6,600,000 pesos—new port construction—19,500,000 pesos—and the improvement and extension of the State railways—12,500,000 pesos.

AN immediate start of the survey of the proposed Moss Vale–Port Kembla, New South Wales, railway, the erection of iron and steel works at Port Kembla by Hoskins, Ltd., and the opening by the firm of quarries near Moss Vale, is provided for in an agreement between the State Government and the firm. An eventual expenditure of £2,000,000 is contemplated by the firm. At first work is to be confined to the manufacture of pig iron, of which it is estimated 3000 tons a week will be manufactured, giving employment to 400 of 500 men. Plans provide for the eventual employment of 3000 men.

THE Irrigation Department of the Government of Bengal has started constructing a special vessel at Dhapa with a conveyor for dealing with the pest of water hyacinth in Bengal. The probable cost of the vessel is estimated at Rs. 10,000. The idea is to use this conveyor for lifting water hyacinth from the smaller waterways of Bengal. The question of the disposal of plants, after they have been uprooted, has also been engaging the attention of the authorities. Two alternatives have been suggested. is possible to deal with the plants either by crushing them or by dumping them on land and destroying them by some mechanical process.

IT is reported by the National Federation of Iron and Steel Manufacturers that, owing to the effect of the general strike and coal stoppage, production of pig iron only amounted to 88,800 tons in May, compared with 539,100 tons in April and 574,700 tons in May, 1925. Of the 147 furnaces in blast at the end of April, only 23 were in operation at the end of May, 124 having been damped down or blown out. The production included 29,900 tons of hematite, 10,700 tons of basic, 37,500 tons of foundry, and 4900 tons of forge pig iron. The production of steel ingots and castings only amounted to 45,700 tons, compared with 661,000 tons in April and 651,600 tons in May, 1925.

THE discovery of wolfram in the Kenhardt district of the Cape Province, adjacent to the Orange River and adjoining the Namaqualand Border, promises, according to the *S.A. Mining and Engineering Journal*, to add considerable tonnage of valuable tungsten ore to the mineral resources of that province. Word of this discovery first reached the *Journal* late last year, but not in detail sufficient to call for mention. Even now it is stated that much intensive prospecting requires to be done before the true extent and value of the deposit can be estimated. Nevertheless, the latter has been traced over several miles, and, as values are reported to be good, there seems to be reason to expect important developments.

THE Government of Bombay has appointed a non-official Committee of four Indians and three Europeans, under the presidency of the chairman of the Bombay Chamber of Commerce, to report what, if any, further portion of the Back Bay reclamation scheme can be undertaken with a reasonable prospect of reducing the present loss, with special reference to blocks 1 and 2. The report will be placed before the Committee of inquiry which the Indian Government decided to appoint on May 19th last. The Back Bay scheme was intended to reclaim about 1100 acres of land from the waters of Back Bay with the object of relieving congestion by extending the area of the city. An investigation into the activities of the Development Department, which was responsible for the work, resulted in the issue last February of majority and minority reports, the latter of which severely criticised the Government and recommended the immediate abandonment of the scheme except possibly for the completion of one block. The majority report recommended that three of the eight blocks originally proposed should be completed, and that the question of completing the rest of the scheme should be postponed until 1927–28.

THE MOFFAT TUNNEL NEAR DENVER, COL., U.S.A.

(*For description see page 2*)

APPROACH TO WEST PORTAL

APPROACH TO EAST PORTAL

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THE ENGINEER.

JULY 2, 1926.

The Facts of Industry.

FOR many years after the opening of that period which covers the so-called Industrial Revolution the employer of labour in factories worked solely for his own profit and pleasure. Individualism was the order of the day. The factory owner was as free from restrictions as the lawyer, the doctor, or the shopkeeper. No one suggested that the employment of labour was a public duty. The country benefited, it is true, from the success of the manufacturer, but that was a secondary effect. The primary object of the employer was to secure advantages for himself. In the course of time that individualistic view has undergone some modification. Many enterprises have passed out of the hands of individual owners and become the property of the public, some are now in the hands of the State, and others in the hands of municipalities. But to this day the greater portion by far of the industries of the country remain the property of private owners; yet the spirit of ownership has undergone a change. The personal has given way, in some degree, to the national. The employer, indeed, still works for his own hand; but, at the same time, he recognises that he is a public servant; since the employment of labour means the provision of the means of subsistence to so many inhabitants of the realm. That is now regarded as the essential object of industry. It is no longer the means of providing riches for an individual or small group of individuals. Its purpose, in the new view, is to give profitable employment to as many subjects of the Crown as possible. In a country like this, which has become industrial to such an excess that it is unable to support its population by natural produce, the man who provides the artisan with the means of purchasing his food from abroad is, in actual fact, performing a service to the realm. Hence it has come about that industry which was once the affair of the individual and nothing more is now regarded to a greater and greater extent as the affair of the public. It follows from this line of thought that the consideration of the units of industry are swamped in the consideration of each industry as a whole—we consider not the welfare of the engineering works of Messrs. A. B. and Co., but of the entire industry of engineering.

Were it not that this view has gained much ground in the last score of years a report entitled "The Facts of Industry," which has just been issued by Macmillan and Co., Ltd., would have fallen upon deaf ears. This report has been compiled and approved by a committee under the chairmanship of Mr. W. T. Layton, editor of the *Economist*. On this committee were Lord Astor, Professor Bowley, Professor of Statistics at London University; Mr. Harold S. Brown, a solicitor; Mr. J. T. Brownlie, President of the A.E.U.; Mr. W. L. Hichens, chairman of Cammell Laird and Co., Ld.; Mr. F. Hodges, Secretary of the Miners' International Federation; Mr. Kenneth Lee, chairman of Tootall, Broadhurst, Lee and Co., Ltd.; Sir William McLintock, a chartered accountant; Mr. J. J. Mallon, Warden of Toynbee Hall; Mr. A. Pugh, Secretary of the Iron and Steel Trades Confederation; and Mr. Seebohm Rowntree. It will be observed that three of the members are associated with three of the most influential trades unions in the country, whilst three represent employers of labour. The object of the report is to advocate the preparation and publication of economic information about great industries. The committee has reached the unanimous conclusion that such information now "available in Great Britain is quite inadequate to enable the country to deal with the difficult economic questions with which it is faced." The report is divided into three main parts. The first handles the proposition that whilst the disclosure of information concerning profits and losses and so on will not create industrial peace, yet it is certain that "industrial peace cannot be attained without it." The second part is devoted to control of trade fluctuations by the compilation and publication of statistics, whilst the third is occupied with the classes of information which should be divulged by joint stock companies. We propose to discuss only the first two sections. It must be recognised that the ignorance of workpeople of the industry in which they are engaged is unfathomable. Furthermore, it must be recognised that very few of them care. The average workman measures the prosperity of a factory by appearances. If he sees his employer living in a big house and driving in a fine car he is satisfied that the business prospers. He goes no deeper and does not know how much he may be deceived. He demands higher wages on the strength of what he sees and nothing more. Whether or not workpeople would be convinced were the figures laid before them we cannot say. Yet since it is common knowledge that they are frequently grossly wrong in their estimate of what their employers are able to afford, the publication of the facts might conceivably do some good. "In an atmosphere of secrecy it is impossible," says the report, "for the wage-earners to be sure that they are receiving equitable treatment." It is true that at times, usually when a wages dispute has to be settled, figures are laid before their representatives, but we doubt that they are ever convinced by such figures. Would they be convinced—we ask not critically, but in the search for information—if statistics were "readily available to the workers' representatives at all times and under all conditions of trade?" On the answer that can be made to that question depends the whole issue, as far as the maintenance of industrial peace by the publication of "The Facts of Industry" is concerned. There are certain inconveniences, on which we need not dwell, in the publication of the facts, and unless we can be assured that such publication will achieve the desired object it would on the whole be better not to attempt it. The public, which would also have access to the statistics, is in a little better case, because a larger portion of it is sufficiently educated to appreciate the real meaning of the figures and because it is free from the inevitable bias which the appearance of affluence of employers gives to workpeople; but we are not persuaded that "Employers would be able to go about their business, in freedom from the constant suspicion on the part of their employees and the public that they were paying too little and charging too much." We wish it to be understood that we do not say this in opposition to the scheme put forward by the Committee. Our sympathies are really with the scheme. We believe that in the long run good would be achieved by the publication of the facts of industry, but when we know that there is a good deal to be said against such publication it is clear that a very strong case must be made out for it before general acquiescence is secured. With the details of the Committee's plan we have, here, no space to deal, but we have no doubt that it will receive from economists the consideration which, unquestionably, it merits.

When we reach the second part of the report we find ourselves on very different ground. Here we are not concerned with the suspicions of workpeople, but with the hard facts of commerce The causes of trades cycle, of booms and slumps, are but indifferently understood. The view which the Committee seems to have taken is that the slump

is the result of over-production during a boom. Hence if each industry would make public all the facts about capacity for output, stocks in hand, orders, and so forth, excessive production could be prevented. Yet since we all hope that the boom of yesterday will be the normal trade of to-day, it is not easy to say when the point of over-production has been reached. America, it appears, lives on over-production. It forces its surplus on its own population and when that is satiated it sells what remains at knock-down prices to foreigners. The world seems to be tending towards that condition in which nothing short of mass production will be profitable. The cost of production diminishes rapidly as the rate of output increases. If, then, we produce only for the market in sight we produce at a high cost and the much larger market which might be secured by a lower price is closed to us. It would seem, indeed, that over-production with a magnificent selling organisation is the key to success in many industries. The danger of attempting to control trade fluctuations by the consideration of statistics is that we are all too likely to use the wrong measure. Trade must be measured by the scale of to-morrow, not by the scale of to-day. Long vision is required, and it is, conceivably, better to over-jump even badly than not to jump at all. We must admit, however, that the trade of Great Britain is peculiar. With a relatively limited home market we cannot make the ventures in which America can safely indulge. It is doubtful that we can, outside certain industries, ever be mass-producers in the American sense of the word. We have our own problems. They are very different from those of the United States, and they must be faced in a different way. America is tackling this question of the statistical control of trade, but if we may judge by the opinion quoted in this report economists are not unanimous in their approval of it.

It will be seen from these few comments on a report which we are confident will be widely read that there is in it much that demands consideration. It opens up for the first time thoughts that have been in the air for years past. Let us say, moreover, that it is thoroughly well done. The Committee is never didactic. It admits that it has no panacea either for disputes or for slumps. It is "not optimistic enough to think that the disclosing of information alone will create industrial peace," nor does it "claim that statistical publicity will eliminate the fundamental causes of trade cycles, and prevent all oscillations of the pendulum of trade." What it does feel is that "it is impossible to formulate a wise policy in industrial and economic affairs without first knowing the facts of the case." It shows us what might be the results of laying full particulars of industry before workpeople, and what might be the result of compiling trade statistics. It gives us also particulars of what has been done, or is being done, in both these directions in Great Britain and in America. In a word, it puts the case before the public. That, we believe, was needed, and the country should be grateful to the Committee for the lucid and temperate course which it has followed. It has presented definite recommendations, and the requisite step is, now, a full and free discussion, not only of the recommendations, but of the premises on which they are founded. The Committee has done its work and done it admirably. It is now for the public, and particularly for employers of labour, to discuss the report in all its details.

The Fuel Problem in France.

A PROBLEM which is particularly occupying the attention of the French at the present moment is how to obtain home and colonial fuels in sufficient quantities to render the country entirely independent of foreign supplies of petrol and coal. This is not only an economical question, but also one affecting national defence, for it is now regarded as indispensable that the country should find, within its own borders, all the fuel that may be required for military transport in time of war. Committees have been formed to investigate the various aspects of the fuel problem, and they are being assisted by chemists, engineers and scientists, many of whom are known the world over for their achievements. This concentration of effort has already produced remarkable effects. The task of investigating new chemical problems and of developing new processes industrially is of so complicated a character, and involves such a vast expenditure of time and money, that progress in this field of research is necessarily slow, but the results achieved are so far promising as to encourage the belief that the French will in time attain the end they have in view of rendering themselves independent of foreign supplies of fuel. It was expected that the promptest effect would be obtained by the utilisation of hydraulic power for the production of a million kilowatts of electrical energy, but this scheme, which appeared simple at the outset, has proved the most difficult of realisation. It was made the subject of a discouraging report to the Chambre Syndicale des Forces Hydrauliques. Apart from what is being done for the electrification of the Paris–Orleans and Midi railways, all the great schemes are in abeyance. Nothing has been done with the Rhone-Rhine and Dordogne projects, and the various private enterprises are at a standstill. The difficulty lies in the reluctance of capital to invest in undertakings which are necessarily costly and cannot be expected to give any return for a considerable time, whereas, for a given power, electrical generating stations with steam plants, cost only a third of the amount, and they almost immediately begin to earn money. Nevertheless, since 1919 hydro-electric installations, representing an aggregate of 240,000 kilowatts, have been completed, and others, having a total of 90,000 kilowatts, may be working up to capacity in two years; but concessions for 361,000 kilowatts have been temporarily suspended or abandoned. On the other hand, steady progress is being made with the construction of generating stations using steam. This result is quite different from what had been anticipated when the national electrification scheme was put in hand, and the late Government therefore proposed to utilise German reparations to carry out some of the bigger proposals and to impose a tax on electricity users for the completion of others. The idea of a tax aroused so much opposition that it is doubtful whether it could ever have been enforced.

While the hydro-electrical plants will doubtless eventually aid in solving the fuel problem by giving an organised supply of current for road traction under conditions which will permit storage batteries to be recharged at low cost, they can only exercise a limited effect in restricting the importation of liquid fuels. It is hoped that still more will be done with the aid of suction gas plants, which are meeting with steadily growing success. The Comité Scientifique du Pétrole has just issued a report upon the trials of suction gas lorries carried out last year in the north of France and in Belgium, when eleven vehicles accomplished a journey of 1300 miles over some of the worst roads in the country. The Committee affirms that considerable progress has been made with suction gas plants for road vehicles, and that, if the reduction of power of petrol engines by some 15 to 20 per cent. by the use of suction gas be accepted, the problems concerning the application of gas to lorries have been entirely solved. The only difficulty now is to ensure sufficient supplies of charcoal, and for that purpose the Office National des Combustibles Liquides is investigating the possibility of procuring the bulk of the requirements from the African Colonies, where it is hoped that improved methods of carbonisation will greatly facilitate the production of charcoal. The home resources are restricted by the necessity of preserving the forests from destruction. Unfortunately, this plan presents problems of labour and of bulky installations, which are not easy of solution; but, in any case, suction gas plants employing charcoal must be regarded as an important factor in the limitation of the importation of liquid fuels. The oldest of the substitutes for petrol is the very one which, until recently, appeared to have the least chance of ever being produced in sufficient quantities at a low enough cost. So many hopes have been based upon alcohol, and so much has been done unsuccessfully to impose alcohol upon motor users, that its failure seemed definite. It is true that the problem of procuring alcohol from the African Colonies is still being investigated, but the economic difficulties in the way of distilling and transporting it at low cost under the conditions at present obtaining in Africa are almost insuperable. Now a discovery has been made which, it is declared, will change completely the aspect of the question. At the instigation of the Comité Central des Houilleres de France, which had more particularly in view the hydrogenation of coal, the Société Nationale des Recherches sur le Traitement des Combustibles installed an excellently equipped laboratory in the works of the Compagnie Nationale de Matieres Colorantes at Villars-Saint-Paul, near Creil, with the aid of funds contributed partly by the Société Nationale and partly by the various colliery, oil, chemical and other industrial associations throughout the country. In his hydrogenation experiments, Monsieur Audibert, the Director of the laboratory, found that by bringing coal to a temperature of from 400 deg. to 450 deg. Cent., according to the quality of the coal, in the presence of hydrogen under a pressure of 150 kilos., he obtained from a ton of coal 200 kilos. of gas and 400 kilos. to 500 kilos. of a liquid composed of phenols and a mixture of hydrocarbons exactly similar to crude petroleum in the proportion of one-quarter and three-quarters respectively. The mixture produced 80 kilos. of petrol, the remainder being heavy oils which were not easily susceptible to cracking. Seeing that hydrogenation required a good quality coal, and involved a considerable expenditure of energy, Monsieur Audibert did not continue his experiments in this direction. He therefore centred his attention upon the synthetical production of alcohol from water gas.

Since the discovery of the catalyser by Professor Sabatier, and the remarkable results obtained by the experimental work of Professor Maihle, the catalytic process has changed completely the aspect of the fuel problem. Little was known of the actual operation of catalysers beyond the fact that they obviously dissociated groups of atoms and reunited them into others, and the extraordinary achievements of Professor Maihle in producing petrol and petroleum from any kind of vegetable and fish oil were based entirely upon empirical suppositions which gave an arduous and indefinite character to research work. It is affirmed that Monsieur Audibert has carried his experiments beyond the stage of supposition, and has discovered a catalyser for producing methyl-alcohol from water gas. It was not only necessary to discover the catalyser, but also the method of using it, and the results obtained were so encouraging that the Société Nationale de Recherches sur le Traitement des Combustibles decided to undertake the synthetic production of alcohol from water gas on an industrial scale. Works are now being erected at Lens for the purpose, and will be completed early next year, when it is hoped that the practically unlimited production of power alcohol will enter upon a definite stage. Whatever may be the result of this industrial effort it is certain that the catalyser opens up a particularly interesting field of research for the synthetical production of liquid fuels.

Telephone Jubilee.

ON Thursday, June 24th, the Telephone Jubilee was celebrated in London by the Institution of Electrical Engineers. Considering the important part which the telephone plays in present-day commercial and social life, it is somewhat remarkable that only fifty years have elapsed since Alexander Graham Bell first succeeded in transmitting speech between two rooms in a house in Boston, U.S.A. Bell was the first to realise that speech could be transmitted over wires if variations in an electric current produced by the speech could be made to move an iron diaphragm in the same way as the air is moved during the passage of sound, and in putting this idea into practice he conferred a great benefit on mankind. Like many other important inventions, Bell's telephone met with considerable opposition at the outset. Even when it was proved that the idea was sound and practicable, the inventor is said to have experienced difficulty in obtaining support from financiers, who regarded the instrument as a scientific toy, whilst the suggestion that public exchanges should be established caused no small amount of amusement.

In 1877 examples of Bell's receivers were exhibited in America, where the telephone has since been adopted on a very extensive scale. At the present time there are about 20,000,000 telephones in use in the United States, and long-distance calls can be made between New York and San Francisco and between Chicago and St. Louis. In this country underground cable networks connect London with all the important cities of the Midlands, the North and the West, and at the present time schemes are being carried out with a view to improving the communications with the northern portion of the European Continent. A third submarine cable to Holland has just been completed, whilst another cable to Belgium is in the course of construction, and is to be followed by an additional link between this country and France later in the year. These cables, which are paper insulated, double lead sheathed, and loaded with inductance and provided with repeaters at their terminals, represent the latest achievements of scientific effort to counteract the inherent defects of high-capacity lines. The development of machine switching, which the British Administration is adopting as rapidly as funds will permit, will ensure a better service than that provided in the past, and will eliminate some of the human weaknesses of the user and operator. The important position which

the telephone has attained can be gauged from the fact that nearly £500,000,000 are now invested in the telephone business throughout the world.

At a luncheon held by the Institution of Electrical Engineers on Thursday, June 24th, Mr. R. A. Chattock (the President) remarked that it was in March, 1876, that Bell was granted his patent for the telephone, and shortly afterwards Lord Kelvin—then Sir William Thomson—had the invention submitted to him whilst acting in the capacity of a judge at the Philadelphia Exhibition. Lord Kelvin immediately recognised its possible utility, and declared that before long people would whisper their secrets over electric wires. That day the telephone was introduced to a larger world. Speaking later, the Postmaster-General said that there were at present 1,430,000 telephones in the country, and that during last year there were over 1,000,000,000 calls. During the last three years something like 800 rural telephone exchanges had been opened. He hoped that the Jubilee would coincide with the installation and completion of the first large London automatic exchanges. Experiments carried out by the Post Office had shown that two-way wireless Transatlantic telephony was well in sight. He and his officers believed in the telephone, and looked forward to the day when this country would take its place among the great telephone-using nations of the world.

After the luncheon the company adjourned to the Institution's headquarters, where the President awarded the Faraday Medal to Colonel R. E. B. Crompton, past-President and hon. member, as a mark of appreciation of his life-long work in electrical engineering. In speaking in appreciation of Colonel Crompton's achievements, Mr. Woodhouse said that his work was too well known to need description. In 1857 he joined the Institution, in 1895 he became President, and in 1908 he was again elected President. In 1923 he was made a honorary member. His principal work in the electrical industry was related to arc lamps, improvements in dynamos, potentiometers and standardisation. Mr. Roger Smith also spoke in appreciation of Colonel Crompton's scientific achievements.

Sir Oliver Lodge then delivered a lecture on the history and development of the telephone, which he described as an instrument of absurd simplicity, invented by one who was not versed in physical sciences, but who was mainly interested in introducing clear intelligibility into human speech. Graham Bell's articulation was of the most precise character, and his manner of speech was a specially noticeable feature of his lectures when he came to England in 1877 and excited the admiration of the members of the Physical Society by his clear enunciation. He had been concerned with the training of the deaf and dumb, and he married a deaf and dumb wife. He was reported to have said that it was fortunate that he was not a fully scientifically trained physicist, for if he had been he would probably have thought that an articulating machine of a simple character was an impossibility.

Crude sounds had been transmitted before by Philp Reis and others. Wheatstone had transmitted the sounds of a musical instrument through a wooden rod to a soundboard, but Bell found how to make the vibrations of an iron plate at one end generate fluctuating electric currents which caused an iron plate at the far end to vibrate in a precisely similar manner, and thus invented the articulating telephone. He (Sir Oliver Lodge) remembered the enthusiasm with which Lord Kelvin, after a visit to America, came back to the British Association in Glasgow with a couple of Bell's early instruments, which he enthusiastically showed to Section A, which met in his own lecture theatre. The instruments were of the simplest character, the sending and receiving apparatus being very much the same. At one end mechanical vibrations generated a current, whilst at the other end that current magnetically reproduced the mechanical vibration. In those early days no energy was put into the circuit apart from that provided by the voice. Very soon afterwards, however, an Edison carbon transmitter and a Hughes microphone, consisting of granulated carbon in the circuit of a battery, were produced, so that the voice merely altered the resistance of the carbon granules; the energy being derived from the battery. In that way it was possible to magnify the voice and to transmit to a distance any reasonable amount of fluctuating energy.

The microphonic transmitter, which was still in use, did not really complicate matters, but there were plenty of complications to-day. Those complications were, however, related to the distribution and the selection of the person talked to. Whenever an invention or discovery got into extensive practical use on a large scale, innumerable practical difficulties were always encountered, and they were nearly always successfully overcome by those who devoted their life to the work. In this country the telephone was received by some men of science with a certain amount of scepticism. The famous chemist, Professor A. W. Williamson, for instance, was very doubtful as to whether the messages were really transmitted by electrical means at all, and suggested that it was more probable that the sound actually travelled between the two places by wire. In 1878, however, Clerk Maxwell in his Rede Lecture before Cambridge University, took the telephone as his subject.

The reasonable attitude of enlightened scientific men in this country to the subject was well illustrated by his opening paragraph, which was as follows: "When about two years ago news came from the other side of the Atlantic that a method had been invented of transmitting by means of electricity the articulate sounds of the human voice, so as to be heard hundreds of miles away from the speaker, those of us who had reason to believe that the report had some foundation in fact, began to exercise our imaginations in picturing some triumph of constructive skill—something as far surpassing Sir William Thomson's siphon recorder in delicacy and intricacy as that is beyond a common bell-pull. When at last this little instrument arrived, consisting as it does of parts everyone of which is familiar to us, and capable of being put together by an amateur, the disappointment arising from its humble appearance was only partially relieved on finding that it was really able to talk."

Although the telephone was simple, it was not to be supposed that that simplicity was arrived at straight away or that the theory of it was unworthy of attention. The instrument consisted essentially of a magnet, a coil, and an iron plate. The coil naturally had an iron core, so as to be an electromagnet, but in combining those three things many varieties of arrangement were possible, and only one arrangement was really efficient. Even the iron plate called for careful consideration. Its best thickness or flexibility was a matter to be taken into account.

In dealing with transmission Sir Oliver remarked that any perfectly insulated transmitting line possessed three definite characteristics which were independent of each other. None of those characteristics could be entirely obliterated, but any one might be reduced to a comparatively small amount. They were resistance, inductance and capacity. A land line had small capacity, whereas in a submarine or buried cable capacity was emphasised. Every line, unfortunately, had resistance, which was wholly obstructive to transmission. It did not help it in the least, for it dissipated energy and converted it into heat. Resistance was therefore a necessary evil.

The only way to reduce the resistance of a metallic conductor to zero was to cool it within a few degrees of the absolute temperature, which could be done in a laboratory by means of liquid helium, but in practice no such scheme was likely to be feasible. If it were, signalling by wire to any distance would be a very easy matter. The effect of resistance alone was attenuation of the signals, their energy being gradually consumed in warming the wire. There was, however, another cause of attenuation, namely, leakage, which would cause attenuation even if there was no resistance, but by the use of good insulation leakage could be diminished to such an extent that its effect might almost be negligible. Capacity did not stop transmission, but only retarded it, making the process slower than it would otherwise be in somewhat the same way as if an ordinary bell were rung by an elastic cord instead of by a rigid bell wire.

The deleterious effect of resistance and capacity in combination was distortion—the obliteration of features and the transmission of pulses of different frequency at different rates, so that if a note and its harmonics were being transmitted as a complicated curve, that curve would not arrive in the same shape as it was sent. The different harmonics would travel at different rates and accordingly the features of the curve would be unrecognisable. That was the main difficulty with which the early telegraphists were confronted when they began to construct and utilise long cables. Lord Kelvin gave the theory of cable signalling, taking into account the effect of resistance and capacity. The problem was, however, attacked later by Oliver Heaviside, who took into consideration a factor neglected by Lord Kelvin, viz., inductance, or rather inductance and leakage, and he showed for the first time how to produce a distortionless cable. The addition of inductance was equivalent to an increase of inertia, and Pupin in America was able to persuade American financiers to risk the construction of loaded cables.

What was wanted in order to avoid distortion was to get all the frequencies to travel at the same rate so as to preserve the features. Heaviside had shown that when the factor of inductance was introduced the law of transmission was entirely modified. There was then some approach to true wave propagation with a definite velocity. There might then be more attenuation, but attenuation alone was not the evil. Many loaded cables were in use, some having inductance coils arranged at regular intervals and some with copper conductors surrounded by iron, especially with a nickel alloy called permalloy, discovered within recent years. Permalloy had a high permeability even with small magnetic forces, so that the iron was worked on the steep part of the curve even when fully magnetised, thus greatly adding to the inertia of the current and enabling it to reach its destination unimpaired. Referring to the question of whether it would be possible to avoid distortion entirely, Sir Oliver said that could be done if the transmitting line were eliminated altogether and the signal were broadcast through the free ether of space, for the ether had properties far more perfect than those of any form of matter.

Mr. J. E. Kingsbury moved a vote of thanks to Sir Oliver Lodge, and Dr. Fleming, in seconding, said that Dr. Bell and himself were fellow students at University College, where Bell's father was a lecturer.

In the evening a conversazione was held in the Science Museum, South Kensington, where some interesting exhibits were arranged in order to illustrate the development of the telephone. The members, associate members, associates, and students, with friends, were received by the President, Mr. R. A. Chattock and Mrs. Chattock and by members of the Council. The exhibition, which is to remain on view for about six weeks, is arranged in two sections, one illustrating the development of the apparatus and the other the line plant. There are samples of the earliest forms of receivers, constructed on the lines of that invented by Bell, and also an example of the earlier Reis telephone invented by Philipp Reis, of Friedrichsdorf, in 1863. Unlike Bell's telephone, however, this apparatus did not transmit speech, but merely served for the transmission of sound. One of the early Bell telephones exhibited is very similar to that shown by Graham Bell at Philadelphia on June 25th, 1876, the diaphragm being composed of goldbeaters' skin with a piece of cork in the centre for connection with the armature. Two subsequent forms of the Bell telephone are also to be seen.

A case contains carbon transmitters as introduced by Hughes in England and Edison in America. The use of a carbon transmitter, operating in a circuit containing a battery, formed a distinct advance on Bell's arrangement, in which the receiver was made to operate both as a generator and as a receiver. A striking contrast is afforded by the presence of a modern wireless broadcasting transmitter, which is close by these primitive and original instruments.

The first step towards the introduction of a telephone system for public use was attained by the invention of the magneto bell by Mr. Watson, a co-partner with Bell, and the utilisation of the magneto generator for producing currents to operate the bell and attract attention to the instrument. This device was quite satisfactory on a direct line connecting two telephones, but it soon became evident that in an exchange system a multiplicity of ringing bells was impracticable. The necessity for a silent and efficient calling system led to the invention of the drop indicator for the exchange ends of the lines and the assembly of the lines on jacks for interconnecting, the whole arrangement with plugs and cords being called a switchboard. The evolution of the modern switchboard is shown at the Science Museum by the display of various types of board.

Besides the manually operated switchboards there are the automatic switching units, which the Post Office exhibited in the Government pavilion at Wembley to demonstrate the method of dealing with the telephone traffic in the London and other large multi-office areas and which are now permanently installed in the Science Museum as working models. On the line plant side of the exhibition samples of paper-core telephone cables of various periods and sizes are shown, and the modern methods of loading cables, either by continuously winding iron or stalloy wire round the copper conductors or by the insertion of coils in the lines at intervals are demonstrated.

The value of the thermionic valve for wireless purposes is well appreciated by the general public, but the part it plays in the transmission of speech along wires is not so well understood. While the practice of placing telephone circuits underground secures stability and a certain amount of freedom from external disturbances, it has a deleterious effect upon speech transmission, for the electrostatic capacity of a pair of wires is much greater when placed close together underground than when placed fairly widely apart on poles. Loading the cables remedies the defect to a certain extent, but long lines are now provided with repeaters, which consist mainly of amplifying valves with devices to stimulate the characteristics of the lines and to suppress echoes. Two repeaters, one for a two-wire circuit and the other for a four-wire circuit, are shown.

The amount of space taken up by underground telephone routes is effectively illustrated by a model of a section of Victoria-street, and shows all the public service mains, including gas, water, and electric light mains and telephones, and includes the manhole at the end of Dean Farrar-street, through which 18,400 wires pass. Specimen joints on cables carrying as many as 2000 wires in a 3in. pipe are shown in various stages of construction. Interesting samples of submarine telephone cables are also on view.

Freedom from inductive disturbance and consequent overhearing or cross talk from one pair of wires forming a telephone circuit to another adjacent pair is largely a matter of construction and laying up of the pairs inside the lead sheath, but most careful selection has to be made during the laying up process of the pairs to be joined so that inequalities of resistance, capacity inductance and insulation may be balanced out throughout the lengths, and an imposing array of apparatus used for this purpose is exhibited.

Among the authorities and manufacturers which have kindly lent or supplied material are the General Post Office, the Institution of Electrical Engineers, the Standard Telephones and Cables Company, Ltd., Siemens Brothers, the Automatic Telephone Manufacturing Company, the Peel Conner Telephone Works, and the British L. M. Ericsson Telephone Manufacturing Company.

BLANCHARD VERTICAL SURFACE GRINDER

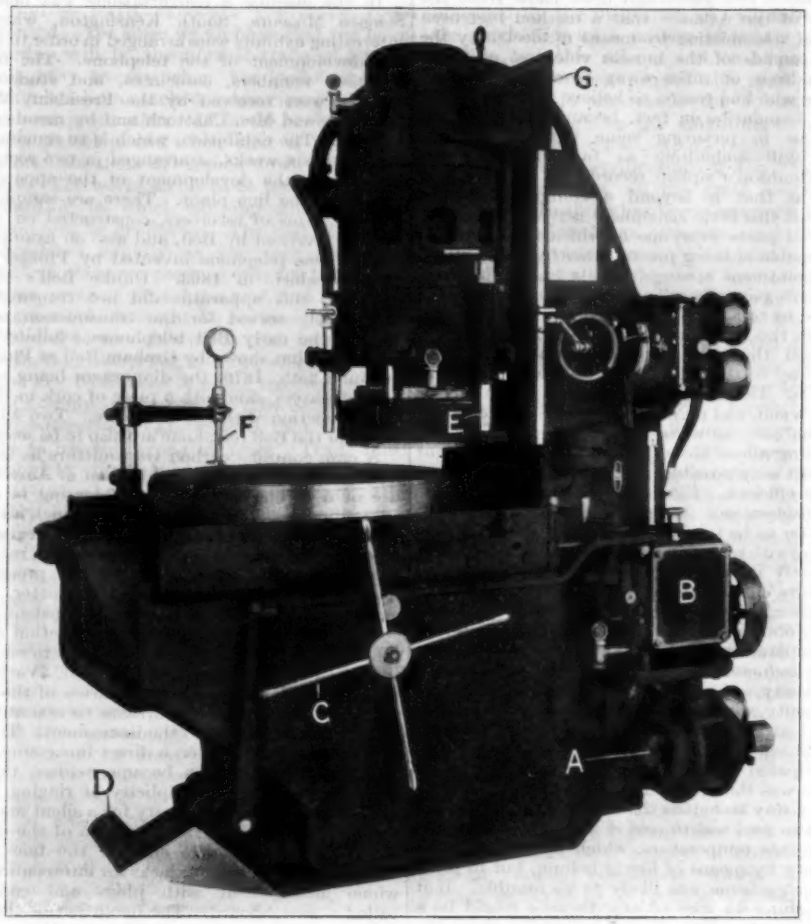


FIG. 1

banding to prevent breakage. The wire bands are stripped off as the wheel wears. A continuously reading calliper gauge F, set to ride over the work, enables the operator

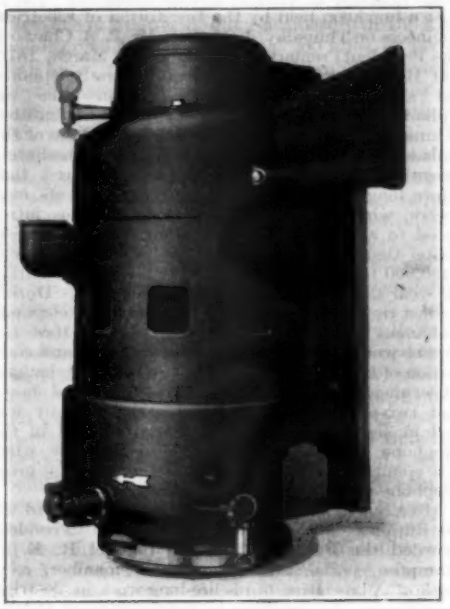


FIG. 3—GRINDING WHEEL HEAD

at any instant to see at a glance how much material remains to be removed.

Should the bearings and slides wear so as to cause the spindle to lose its squareness with the chuck, the column can quickly be re-aligned by the aid of a spanner. The column, as shown in Fig. 2, is bolted to the base at three points, A. Screwed bushings surround the bolts and can be made to lift or lower the column through the agency of washers provided with projections on

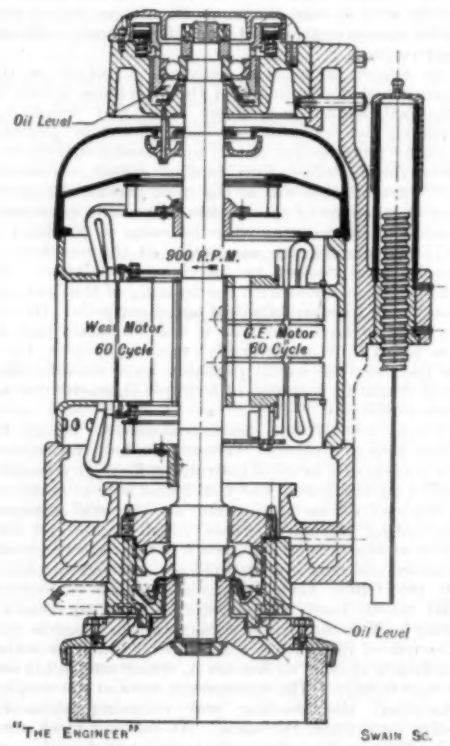
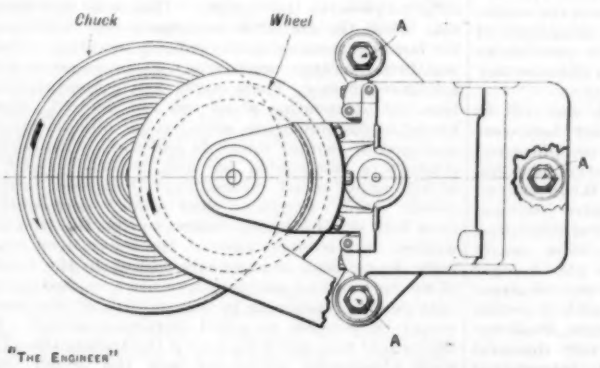
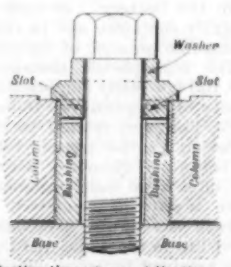


FIG. 4—SECTION OF HEAD AND MOTOR





Section through one of the three adjustable column supports

SWAIN SC.

FIG. 2—METHOD OF RE-ALIGNING COLUMN

Diesel Engine Users Association.

AT a meeting of the Diesel Engine Users Association, which was held on Friday, June 25th, Mr. J. E. Hackford presented a paper on "Some Deleterious Properties of Lubricating Oils." The inherent and comparatively innocuous acidity of an oil is to be distinguished from deleterious acidity, which tends to develop in an oil during its subsequent use in service. For the purpose of comparison, 10 grams of lubricating oil were heated in a flask and maintained at 150 deg. Cent., oxygen gas being bubbled through the oil. After periods of three, six and nine hours the contents of the flask were titrated. The results, which in the paper are expressed both in curves and tabular form, show that the paraffin or aliphatic series as represented by the Pennsylvanian oils are most resistant to oxidation. The least resistant are naphthenic or heterocyclic series, represented by heavy Russian solar oils, while mid-continental oils occupy a middle position. Mexican oils, which generally consist of paraffin mixed with a small proportion of thicethers, are nearly allied in their properties to the Pennsylvanian types. The author proposes that samples should be subjected to a standard nine hours' oxidation test, and that determinations should be made of the inherent acidity and the subsequent acidity after nine hours' treatment. If, then, the inherent acidity be deducted from the total acidity after treatment, the result can be expressed as a factor indicating the rate of acidity formation. A series of seven different cylinder and lubricating oils were examined and their acidities expressed in cc. of N/10 KOH per 10 grams of lubricating oil. The inherent acidity is shown to vary from 0·18 to 4·6, the final acidity from 0·94 to 20·5, and the rate of acidity formation—Hackford's factor—from 0·42 to 15·9. The effect of electrolysis taking place on account of ionisable acids and salts present in solution was investigated by inserting copper foil strips into a 50 c.c. U tube filled with an aqueous filtered solution of the oil to be tested. The electrodes formed by the copper strips were connected to the millivoltmeter indicator of a Cambridge pyrometer equipment reading in degrees Centigrade. It was found that the comparatively weak acidity of an unused new lubricating oil was at least partly soluble in water and was capable of acting as an electrolyte. With oils having an inherent acidity of 0·36 and 4·6 respectively, deflections of 50 deg. and 140 deg. were obtained, while for unused oils the deflections ranged from 40 deg. to 80 deg., and for used oils from 80 deg. to 675 deg. It is suggested that used oils giving a deflection of over 170 deg. should be re-treated for acidity or discarded. The author finds that the addition of a small quantity of either oleic or naphthenic acid to a lubricating oil causes a large increase in the deflection. Thus, the addition of 1 per cent. of oleic acid to a Pennsylvanian oil gave a deflection of 130 deg. and 1 per cent. of naphthenic acid a deflection of 120 deg., the original deflection being 40 deg. It is suggested that if properly standardised, such a method should prove to be of advantage to chemists in the determination of acidity of oils, as it would overcome the difficulty now often experienced in accurately auging the end point of the titrations.

Motor-driven Vertical Surface Grinder.

THE high-power vertical surface grinder made by the Blanchard Machine Company, of Cambridge, Mass., U.S.A., and illustrated herewith, is already fairly familiar in this country. Recently, however, the wheel head embodying the 25 horse-power induction motor which drives direct on to the wheel spindle has been re-designed and simplified, and it is with it that we are now mainly concerned. A brief general description of the machine may, however, prove of interest.

The work is supported on a 26in. magnetic chuck taking a little over one-third of a kilowatt, direct current. To load the chuck with work the sliding carriage on which it is mounted is pulled outwards. This movement automatically opens the water guards surrounding the chuck. These guards are not shown in our engraving of the machine. The chuck when loaded is returned inwards until its centre is approximately below the foremost point on the periphery of the grinding wheel. A 2 horse-power motor A, Fig. 1, and a change gear-box B drive the chuck at any one of six speeds ranging from 5 to 28 revolutions per minute. The grinding wheel runs at 900 revolutions per minute. Hand or power feed in the downward direction can be applied to the wheel head as a whole, the power feed ranging from 0·0002in. to 0·005in. per revolution of the chuck by steps of 0·0002in. Rapid power motion is provided for raising and lowering the head when it is necessary to change to work of a new height. The horizontal movement of the chuck carriage is not employed to feed the work beneath the wheel, but simply to facilitate loading. This movement is effected by the star handle C. A treadle D enables the chuck to be rotated during the loading period. At E is shown a wheel dresser, which can be operated, if desired, while the wheel is actually grinding. The wheel is 18in. in diameter and 5in. deep, and is provided with a wire

their undersides to engage slots in the tops of the bushings.

The wheel head is illustrated in Figs. 3 and 4, and in Fig. 5 the spindle is shown separately. The motor, either a Westinghouse or a General Electric machine, is built round the spindle. Above and below the motor armature the spindle carries fans which ventilate the motor by drawing in air through the duct G, Fig. 1, and delivering it through openings in the side of the head casing. Two large ball bearings of the radial thrust type support the weight of the spindle and its attachments. The top ball bearing is held up by springs which take up all end play, and, in addition, throw at all times a considerable upward thrust load on to the lower or main bearing. This lower bearing contains eleven balls, 1⅛in. in diameter. In the earlier design of the machine the spindle was carried in four bearings, namely, two thrust and one radial ball

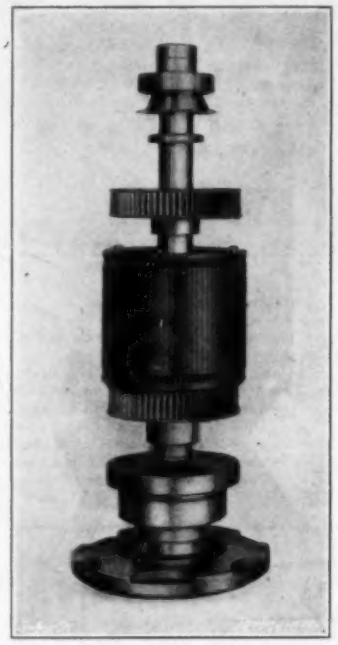


FIG. 5—SPINDLE OF WHEEL HEAD

bearings and a bronze bushing. The wheel is set in sulphur or cement in a cast iron ring, which is attached by six bolts to the face-plate on the spindle. A guard surrounds the wheel and is attached directly to the head and not to a spider casting, as was formerly the case. In the base of the machine a tank is formed for the reception of the cooling medium. From this tank a pump driven by the 2 horse-power chuck motor delivers the liquid on to the work through a nozzle fixed against the outside of the head casing. In addition, the liquid is also delivered into the interior of the grinding wheel by way of a passage leading downwards and outwards from behind the spindle face-plate to the front. The swarf returning with the cooling medium to the tank in the base is removed therefrom by means of a hoe, the tank, to facilitate this cleaning process being formed with a sloping wall at the front.

A New Conical Rotary Pump.

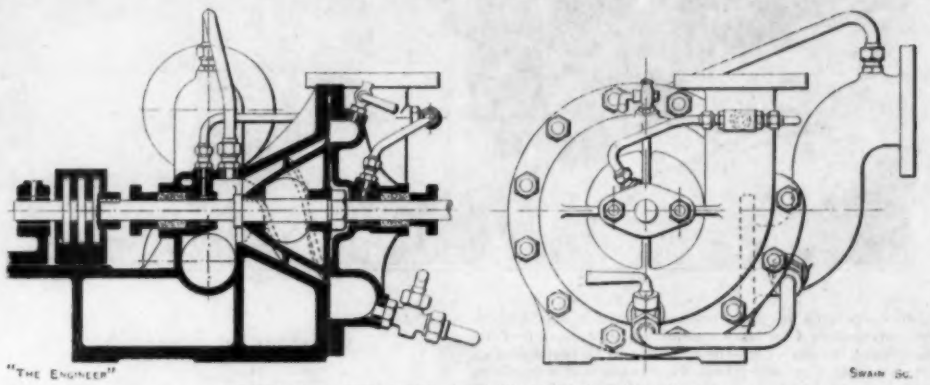
DURING a recent visit to the works of A. G. Mumford, Ltd., of Colchester, we saw under construction a new type of conical rotary pump which the firm has recently designed for oil fuel, brine pumping and general work.

The accompanying illustrations show a 3in. model of the new Niagara conical pump, which, it will be seen is constructed with a vertical end joint. We learn, however, that the patented design is equally applicable to the construction of pumps with a horizontally split casing. In the accompanying drawing we reproduce a longitudinal section and an end view of the pump.

The main casing is conical in form, with the inlet passage arranged at one end and the volute, which leads to the discharge branch, at the other. It will be seen that the pump body is cast in one piece with the ribbed base, a sturdy construction thereby being obtained. The bed-plate also forms a stool for the thrust block and outer bearing, while on the main pump body side lugs are cast, through which the anchoring bolts for the thrust bearing are passed and are adjustably secured.

In the place of the impeller of the ordinary centrifugal pump, a cone-shaped worm, which is furnished with spiral threads on its outer periphery, is employed. These threads may be varied in number and pitch to meet different operating conditions, and it will be seen from the section given that their depth varies through the length of the worm, so that the desired area in the annular space between the worm body and the pump is obtained. Vanes are fitted on the end face of the worm body, so that the pressure in the recess between the worm and the centre of the end cover is reduced. The worm is keyed to the spindle and is held in position by a locking nut. Water-cooled bearings are provided, and each is sealed from a suitable connection on the discharge branch. The cooling water is delivered to a recess formed in the bearing brass. At the inlet end of the pump the spindle is extended to carry a thrust collar, which, in the particular model we illustrate, is keyed to the pump spindle, and so allows the worm and spindle to be withdrawn by removing the cover at the discharge end. The thrust block may be of any type, that shown being a solid three-collar thrust bearing with its rubbing surfaces running in an oil bath. It may also be water cooled if desired. The anchoring bolts allow of a very fine adjustment being made between the tips of the worm threads and the inside of the pump casing, it being possible, if desired, to bring these parts into actual rubbing contact. Such adjustment can quite well be made whilst the pump is in operation. A bearing is provided at the extreme end of the pump to carry the thrust shaft, and, if required, an additional bearing can be fitted at the opposite end of the pump between the stuffing-box gland and the shaft coupling.

For pumps which have a suction lift, the inlet branch—as shown in the end view below—can be raised to any desired height so that a certain amount of water remains within it, and the pump is self-priming. A pipe connection is fitted to preclude the possibility of the pump and



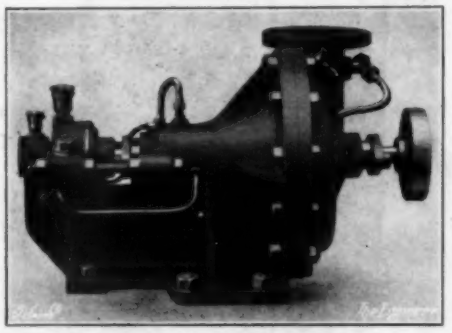
SECTION AND END VIEW OF MUMFORD CONICAL PUMP

inlet branch passages being emptied by syphonic action. When starting up under normal conditions the revolving worm draws the water from the inlet pipe and discharges it into the volute chamber. The water is then prevented from flowing back by the revolving worm which continues to exhaust the air from the inlet branch and suction pipe, and thus automatically primes the pump. A by-pass connection between the discharge and inlet ends provides sufficient water for sealing the tips of the worm threads. In practice very little water is required for this purpose, and once the pump is primed the cock on the by-pass pipe can be closed. An air cock is fitted on the highest part of the discharge volute.

The following are some test figures obtained by the makers during a series of runs of the 3in. pump, with a 2ft. 6in. suction lift and a 100ft. discharge head. The speed was varied between 2660 and 3400 revolutions per minute to obtain the desired deliveries.

Revs. per min.	Tons per hour delivered.	Gallons per hour delivered.
2,660	20	4,480
2,740	30	6,720
2,820	40	8960,
2,900	50	11,200
3,000	60	13,440
3,170	70	15,680
3,400	80	17,920

As regards the size, weight and output of the new pump, we understand that it compares advantageously with the



THREE-INCH MUMFORD CONICAL PUMP

ordinary design of centrifugal pump, whilst the cost of production is, we understand, also favourable.

The pump has been thoroughly tested, both on fuel and lubricating oil, with good results, and with larger outputs and higher delivery heads than are usual for a centrifugal pump of equal size. For brine pumping, the high pressure against which the new pump will deliver should prove an advantage, as it is claimed that it will deliver brine against a much higher pressure than would an ordinary pump, should a block occur in the brine system. For high-delivery heads two worms can be arranged on the same shaft with the pumps so grouped that the two discharge pressures will balance one another. In such a case the thrust block would be used for adjustment only.

Navigation Works on the Danube.

THE correspondent of *Le Temps* in Rumania has recently published in that paper some particulars of the navigation works on the Danube. From his articles we take, with due acknowledgment, the following notes :—

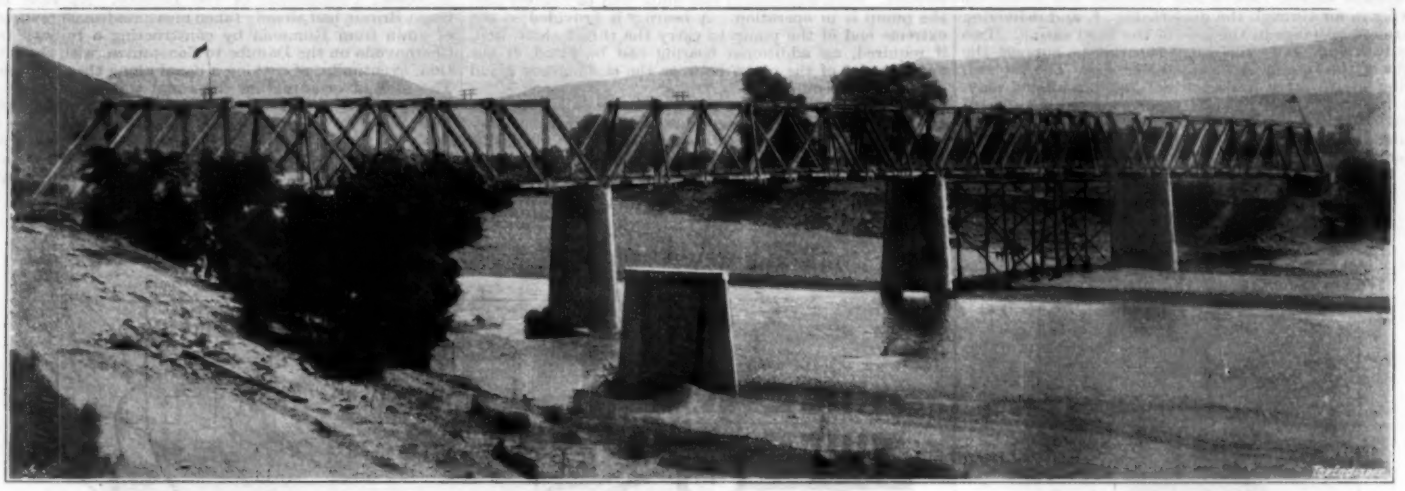
The silting up of the Danube delta is a danger which has been recognised for nearly a century, and has become so serious of late years as to threaten the economic prosperity of Rumania and some of the Central European countries that depend upon the Danube for the greater part of their export trade. The first attempt to remedy the evil was made in 1856, when the Treaty of Paris took the control of the delta out of the hands of Russia and created a European Commission of the Danube. At that time Great Britain had already taken measures to ensure supplies of grain from Rumania by constructing a railway from Chernavoda on the Danube to Constantza, with the intention, eventually, of making a canal along the same route. The idea of constructing the canal was revived by the Germans during their occupation of Rumania, and complete plans were drawn up, but the European Commission has definitely abandoned the scheme because the canal would have to pass, for a quarter of the distance, through a tunnel, and could, therefore, not be adapted to maritime traffic.

When the Commission was constituted in 1856, Great Britain sent Sir Charles Hartley to Rumania to prepare and carry out plans for ensuring the navigability of the river from Galatz to the Black Sea. As offering the most immediate and economical solution, Sir Charles Hartley undertook the dredging of the Sulina arm and the construction of a mole to protect the port of Sulina from the alluvium washed down from the delta. This provisional undertaking gave such satisfactory results that the dredging was continued until 1914 without its being deemed necessary to embark upon more ambitious and more costly works. At that time the navigable channel between Galatz and Sulina had a depth of 24ft. During the war it was found impossible to keep open the channel, which again silted up, and when the European Commission was able to resume operations on a more considerable scale, the quantity dredged increased from 941,000 cubic metres in 1918 to 1,200,000 cubic metres in 1925. Additional dredging plant continues to be employed. Notwithstanding these efforts the depth of the channel cannot be maintained at more than 20ft., and sometimes it is not more than 13ft., with the result that navigation is almost entirely suspended for the larger cargo boats. The dredging problem is complicated by the huge quantities of sand which are brought down by the swift floods of the Staroe-Stambul arm to the north of Sulina, pushing the delta forward at the rate of nearly a kilometre a year, and forming a bay which prevents the sea currents from sweeping the sand away from the port.

In 1921 the Commission came to the conclusion that dredging alone would not keep the port of Sulina open, and it was decided to extend the mole to resist the invasion of alluvium from the Staroe-Stambul, at the same time that it would permit of currents sweeping round to keep the entrance of the harbour free of sand. The mole constructed by Sir Charles Hartley was extended for a distance of a mile, but the result was not so satisfactory as had been anticipated, for entrance to Sulina is rendered impossible to large boats by a sand bar which forms every time the Danube is in flood. At times as many as thirty-five boats have been held up at Sulina through being unable to cross the bar, and others have had to remain in the channel for weeks together. Recently the timber docks at Galatz contained 25,000 loaded trucks which could not be discharged for shipment. The losses incurred are so considerable that the European Commission, at its last session, came to the conclusion that some drastic measures must be taken to cope with the situation. The members of the Commission present were Mr. G. Y. Baldwin for Great Britain, M. F. Charles-Roux for France, M. C. Rosetti for Italy, and M. Contzesco for Rumania. They were assisted as experts by Messrs. Luiggi, Italy ; Watier, France ; and G. Popesco, Rumania. It seems to be recognised that the efforts to keep the port of Sulina open by dredging are destined to fail in view of the increasing quantities of alluvium which are swept down from the north, and although the Commission intends to accentuate the dredging operations, as being the only thing possible at present, it is obvious that Sulina will never be able to accommodate ships of 8000 tons to 10,000 tons, which are regarded as indispensable for the development of the Danube export trade.

Among the proposals being examined by the Commission of experts is the dredging of the arm which branches off from the river near Toultcha to St. George, lying on the coast to the south of Sulina. This work was included in the original plan of Sir Charles Hartley, but it is now seen that the St. George arm offers the same drawbacks as the Sulina, though to a less degree. Another proposal is to construct a canal due south from the upper part of the St. George arm to the little coast town of Gura-Portitzei. The plan, however, which appears to offer most chance of success is the utilisation of the Kilia arm, from which extends the Staroe-Stambul, to the north of Sulina, where there is a number of small ports capable of being developed into a great maritime centre, and there would be no difficulty in keeping the port open at all seasons. Whichever plan is subsequently adopted the cost of carrying it out presents serious difficulties. An estimate made in 1924 gave the cost at something like 25 millions sterling. As the entire work has to be carried out by the European

THE ROTOKAUTUKU BRIDGE OVER THE RIVER WAIAPU, NEW ZEALAND



Commission with its own resources, which are derived from navigation fees that cannot be increased unduly, it is difficult to see where the money will be forthcoming. Rumania and the other Danube States will contribute what they can, but it is suggested that the work can only be undertaken with the aid of a foreign loan. Until navigation between the Danube and the Black Sea is ensured by one of these schemes, the Rumanian export trade will always be carried out under extremely precarious conditions.

Rotokautuku Bridge Over the River Waiapu, New Zealand.

THE accompanying engraving represents the recently completed Rotokautuku Bridge over the River Waiapu, in the Gisborne District of the North Island, New Zealand. The bridge consists of four 140ft. spans and one approach span of 20ft., the total overall length being 589ft. Each of the cylinders is 7ft. diameter, sunk 12ft. to 14ft. into solid papa. The two end spans and one intermediate span were assembled on the bank, and launched into position, the remaining one being built *in situ*. The risk of flood in respect of the last named was one which would only be taken in the summer period, when the weather appeared well settled.

The estimated cost of the bridge was £21,530, and the actual cost £23,570, of which £18,570 was contributed by the Government and the balance by the Waiapu County Council.

Evidence of the initial attempt to span the river at this point is to be seen in the engraving, one of the original piers, which were of a much lighter design, and built on driven piles, being visible beneath the new bridge. Disaster befell this structure in 1916, when one pier was carried away, and another, which was carrying the skeleton superstructure, was so badly damaged by the battering to which it was subjected, as to become useless. Flood waters have since overtopped this pier.

A feature in connection with this site is that it is situated a few chains below the confluence of two channels, from which point the photograph from which the engraving was made was taken, and this fact results in a tendency to pile up the flood waters in the centre of the stream, though as a fact such piling up is noticeable to a greater or less extent over the whole course, from the bridge down.

It is of interest to note that within living memory there has scarcely, if ever, been a year in which the Waiapu River has failed to take toll of human life, sometimes one, sometimes more, the fatalities usually occurring at the site of the Tikitiki crossing, 11 miles nearer the coast, which is also the site of a wasted effort, the attempt to hold a bridge which was erected having to be abandoned and the bridge dismantled.

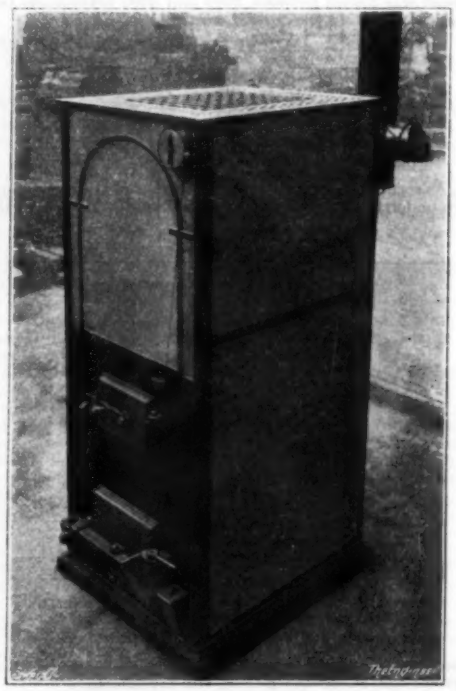
The rainfall is particularly heavy for this coast, amounting, as it does, up to 181in. for the year, and at times tropical in its intensity, 31in. in five days being a known quantity. This is due principally no doubt to the proximity of the Honokawa Range, which rises to a height upwards of 5000ft., within a distance of 20 miles of the site. The clearing of the bush has also speeded up the run-off very materially, and floods now show a considerable increase in volume, as compared with conditions which prevailed ten to fifteen years ago. Another feature is the unstable nature of a great deal of the middle slopes, which is aggravated by the decay of the roots of the forest with which the country was once so heavily clothed. In times of ordinary "freshes" huge "fans" of shale and detritus of varied description are deposited at the mouths of the larger tributaries of the two main sources of the Waiapu River, the Mata and the Tapuaeroa, and when a flood occurs these deposits are carried down, and the bulk of the material is distributed along the main river bed and its banks, from where the litter emerges from the hills into the open valley. This action is, of course, a considerable factor in increasing the heights of successive floods.

THE directors of the Prague Sample Fair, to be held from August 29th to September 5th, state that there will this year be established a section for the mining industry. All goods and products connected with the industry may be exhibited in this section.

A Workshop Heater.

ON a visit made some time ago to Birmingham we noticed in the shops of Wm. Grice and Sons, in Fazeley-street, some heating stoves of a new type, and in view of the pleasant warmth they were producing, we give below a few particulars of the apparatus.

The stove is really very simple in construction, but it has required a considerable amount of investigation in order to arrive at the best possible proportions, and it seems to us that a satisfactory means of heating large spaces by means of warm air has been produced. As will be seen from the line drawing, there is a cast iron combustion chamber, ribbed inside and out with a double outer casing of sheet metal. The spaces between these casings provide passage for the air to be heated, by direct contact with the exterior of the furnace. The air enters at the top of the outer casing, flows downwards and rises again between the intermediate casing and the furnace walls, to escape through

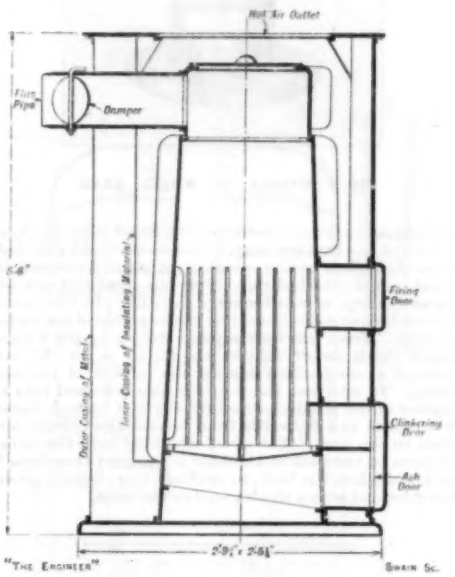


THE GRICE WORKSHOP HEATER

the grating at the top. At no time is there any possibility of the air being contaminated with the products of combustion, and the cooling of the furnace walls, by the circulation of the air, is so effective that no refractory lining is required. Two troughs are arranged in the space where the air passages meet at the bottom of the stove, and can be used for humidifying the air or disinfecting it. There is an ordinary firing door, about waist high, and an ash door which has an excentric clamp to ensure that it is closed air-tight. The air necessary for combustion is supplied through a separate rotary louvre, which is made so nicely that it can be closed virtually air-tight. A damper in a branch of the stack pipe can also be used for checking the draught through the fire.

As we have already suggested, the feature about these heaters which struck us most was the remarkable evenness of the temperature throughout a considerable-sized shop with several open doors, but it was also noteworthy that a hole, about a couple of feet square, cut in the floor of a passageway, and, naturally, protected by a grating, provided enough warm air from a stove several yards away to heat a range of offices above, while another office was effectively warmed through an opening no larger than that of a letter-box.

It is very difficult to estimate quantitatively the efficiency of heaters of this class, as results are influenced so largely by local conditions, but the makers tell us that long-period trials have shown that a consumption of only 1¼ lb. of broken coke per hour is required to maintain a temperature of 125 deg. Fah. at the air outlet. The heater on which this result was obtained is also capable of delivering 25,000 cubic feet of air per hour at a temperature of



ARRANGEMENT OF HEATER

250 deg., but at a slightly higher consumption. The heater also has the advantage that it can be "banked" very effectively, and, as is shown by pyrometer charts, will maintain an almost even temperature throughout a week-end without attention.

WORLD POWER CONFERENCE.

To enable Great Britain to participate in the future activities of the World Power Conference on lines commensurate with the position she now occupies as the convener and organiser of the First World Power Conference, a British National Committee has been formed as follows:

Government Departments.—Admiralty, Engineer Vice-Admiral Sir Robert Dixon, K.C.B.; Air Ministry, Lieut.-Colonel J. D. K. Restler, O.B.E.; Ministry of Transport, Mr. J. R. Brooke, C.B.; Home Office, Mr. L. Ward, O.B.E.; Department of Scientific and Industrial Research, Dr. C. H. Lander; Imperial Institute, Lieut.-General Sir Wm. Furse, K.C.B., D.S.O.; Electricity Commission, Sir John Snell, G.B.E.

Institutions.—Institution of Civil Engineers, Sir Charles L. Morgan, C.B.E., Sir Dugald Clerk, K.B.E.; Institution of Mechanical Engineers, Mr. W. H. Patchell; Institution of Electrical Engineers, Mr. R. A. Chattock; Institution of Gas Engineers, Mr. C. F. Botley.

Industrial and Technical Organisations.—Association of Consulting Engineers, the Chairman (Mr. E. W. Monkhouse); British Electrical and Allied Manufacturers' Association, Colonel R. K. Morcom, C.B.E., Sir B. Longbottom, Mr. P. J. Pybus, C.B.E., Mr. D. N. Dunlop; British Electrical Development Association, Mr. J. W. Beauchamp; British Engineers' Association, Mr. D. A. Bremner; Cable Makers' Association, Mr. L. B. Atkinson; Electric Lamp Manufacturers' Association, Mr. C. W. Sully; Federation of British Industries, Sir Robert Hadfield, Bart., F.R.S.; Incorporated Municipal Electrical Association, the President (Mr. R. B. Mitchell); National Gas Council, Mr. D. Milne Watson, D.L.; National Physical

Laboratory, Sir J. E. Petavel, D.Sc., F.R.S.; Society of Chemical Industry, Dr. H. Levinstein.

Individuals.—Mr. Charles H. Merz, Mr. Roger T. Smith, Mr. C. P. Sparks, C.B.E.

Dominion Representatives.—Australia, nominations not yet made; Canada, nominations not yet made; India, Mr. J. W. Meares; New Zealand, Mr. R. J. Harvey; South Africa, nominations not yet made.

At the first meeting held recently Mr. D. N. Dunlop and Mr. C. Rodgers were appointed chairman and secretary respectively of the Committee, and an Executive Committee was also appointed, composed of fourteen members.

A Tree-felling Band Saw.

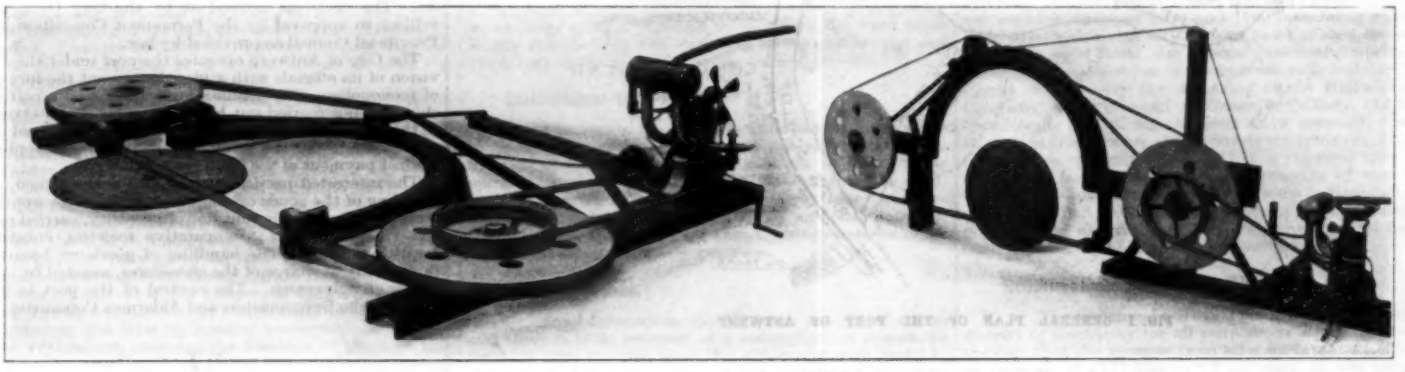
We have received from Mr. John T. Pickles, of Mytholm House, Hebden Bridge, Yorks., some particulars and illustrations of a new form of tree felling saw which he has recently produced, that embodies a rather novel feature.

Reciprocatory saws have, of course, been used for tree felling for many years past and, in their way, are most effective, but an engineer only naturally prefers to employ a continuous motion rather than a reciprocatory one. For this reason Mr. Pickles has adopted a band saw and has overcome the objection, which would otherwise arise, of the saw making two cuts across the tree by twisting the saw on itself through a right angle.

On reference to our engravings it will be seen that the saw is normal to the extent that it runs over two pulleys—they are aluminium castings—fixed in a frame, which is bowed to accommodate the girth of the tree to be felled. A jockey pulley on a spring-controlled lever is provided to keep the saw in tension, and one of the main pulleys is driven by means of a vee belt by a 3½ horse-power air-cooled petrol engine. The pulleys are fixed in a frame lying in a horizontal plane, and the saw is presented in such a manner that it can make a horizontal cut by twisting it along the working length through a right angle. This twisting, it will be seen, is effected by two pairs of rollers mounted on extensions of the U-shaped frame. The consequence is that the saw can make a cross cut which is only limited by the capacity of the frame and, in the case of the machine illustrated, it will go through a tree 4ft. in diameter. The U frame is pivoted to a channel iron base at the centre of the saw pulley in the foreground, and the whole arrangement is fed into the cut by means of a wire rope spiked to the tree stump, running over a pulley on the frame and wound on to a little hand winch, which can be seen just behind the engine.

The saw itself, which is 1¼in. wide and rather thin, so that it may readily accommodate itself to the twisting process, runs at a speed of from 3000ft. to 4000ft. per minute and will, we understand, go through a tree 3ft. in diameter in from two to three minutes. It can also cut as close to the ground as 6in., so that a considerable amount of timber can be saved, as compared with the usual hand practice of felling trees breast high.

By erecting the framing on edge, as shown in our second illustration, and appropriately re-arranging the engine, the saw can be used for cross cutting felled logs, while it can be mounted on a travelling trolley and used to convert them into scantlings. The total weight of the machine is approximately 5 cwt., and the heaviest single piece weighs 120 lb.



BAND SAW FOR FELLING TREES AND CROSS-CUTTING FELLED LOGS

South African Engineering Notes.

Cape Town Train Disaster.

On Wednesday, June 9th, an accident to a passenger train on the suburban line between Cape Town and Simonstown resulted in the death of fifteen people, while twenty-six others were seriously injured and many more received minor hurts. The 5.2 p.m. express from Cape Town to Simonstown, carrying about 300 passengers, and having its first stop at Claremont, 6 miles out, was approaching Salt River Station, 2 miles out from the city, at a speed of about 30 miles an hour, when the disaster occurred. There is a bridge running diagonally across above the railway tracks, and carrying the main highway to the north just before the station is reached. Immediately before the approaching express came into view of the people on the Salt River platforms, a series of sharp reports was heard. Then the engine and the first four coaches appeared under the bridge, a tremendous cloud of dust in their wake, where the second half of the train, uncoupled and derailed, was bumping over the sleepers and tearing up the permanent way. There was a tremendous crash as two of four steel pillars supporting the bridge were struck by the last but one of the coaches and the pillars wrenched from their concrete foundations, while the coaches became a mass of wreckage. Breakdown gangs speedily got to work, and in a couple of hours trains began to run again at irregular times, and normal traffic conditions were restored before the start of Thursday's passenger traffic.

The principal cause of the heavy death roll was the collision with the steel pillars, which ripped the first of the two rear coaches from end to end, carrying away one side. One of the other coaches—there were four in all—appears to have collided with a tender of an engine proceeding with a train of cattle trucks on another line. The engine and first portion of the passenger train was pulled up safely some 400 yards beyond the station.

The cause of the accident was a broken coupling brought about, apparently, by a safety screw coupling which was found driven deep down between one of the running rails and a safety rail, and which had caused the coaches to leave the line. The accident is very nearly the worst that has ever occurred on the South African Railways, and nothing like it in seriousness has ever before taken place on the Cape Town suburban lines.

Biggest Copper Producer.

Some interesting facts and figures concerning the activities of the Union Minière du Haute Katanga, in the Belgian Congo, the world's richest and most important copper producer, have been supplied by the managing director. The company owns twenty-one boring installations, which are used for prospecting work, and for some years past it has carried out drilling operations at the rate of 50,000ft. to 80,000ft. per annum. The average depth of the boreholes is about 400ft., but some of them are nearly 800ft. deep. That the company is able to carry on operations on a very large scale is mainly due to the employment of labour-saving machinery. Before long fourteen high-capacity steam shovels—some of them mounted on caterpillars—will be at work in the company's mines. Each of them raises and removes 1000 tons of ore per day, and performs the work of 300 to 400 natives. When the company is producing 200,000 tons of copper per annum it will have to extract annually 3,000,000 tons of ore and 4,000,000 tons of barren ground. At present the amount of ore and flux matter extracted per annum is 1,800,000 tons. Amongst the other labour-saving implements used in these mines are scrapers, each of which extracts 150 tons of ore daily and performs the work of twenty to thirty natives. When it lays the foundation of its new buildings the Union Minière will use Frankie piles, thereby saving two-thirds of the unskilled labour which would otherwise be required. A great deal of labour is saved by using pulverised coal for fuel in place of wood. The company makes its own coke from Rhodesian coal, and owns and operates 56 locomotives, 120 large wagons, and 1400 small ones. The wagons are all designed to save native labour. In 1924 the number of natives permanently employed by the Union was 2600; by the end of 1925 the number had increased to nearly 6000. The "boys" are engaged by recruiting agents, and many of them are brought from distant parts of the country. From 13,000 to 15,000 Congo natives are required to work the copper mines to their full capacity—that is to say, more than double the number at present permanently employed—and efforts are being made to obtain larger supplies of labour from Northern Rhodesia. At the same time the company is asking the Belgian Congo Government to grant facilities to enable it to obtain a larger number of Congo natives so as to increase the scale of its operations.

Remarkable Cooling System.

The water and cooling system at the Witbank power station, the first 20,000-kilowatt set of which is now in commission, is a remarkable achievement. The Olifants River, 6 miles away, has been dammed up in the hills by Mr. Kantbanch, late director of irrigation for the Union Government. By means of this dam 1,300,000,000 gallons of water are stored. The dam itself is 3¼ miles long. The water, after passing through the condensers at the power station, is conveyed in a pipe 3ft. in diameter to the spraying system in the pond adjoining the station, where it is sprayed up into the air from a network of pipes. The pond was formed by the excavation of 80,000 cubic yards of earth. When cooled the water goes back along a canal into the condensers again. About 1½ million gallons of water pass through the circulating system in an hour.

Jackhammer Progress.

Undoubtedly one of the most important developments on the Rand during late years has been the increased adoption of jackhammers, and recent reports of leading producers show that further progress towards maximum efficiency in the use of these machines was made last year. At the Crown Mines during 1925, 97·5 per cent. of the total fathomage mined was broken with the aid of jackhammer machines, against 90·5 per cent. in 1924, and the following gives some idea of the progress made in the last three years:—Fathoms broken in 1923, 59,461; 1924, 150,053; and 1925, 169,517. Machine shifts worked, 57,673, 86,194, 83,090. Fathoms per shift, 1·03, 1·74, 2·04; cost per fathom, 53s. 7d., 41s. 9d., 37s. 11d. The company's total working cost per ton milled fell from 22s. 5d. in 1922 to 18s. 9d. last year. The City Deep reduced its cost per fathom mined by the jackhammer from 46s. 3d. in October-December, 1923, to 32s. 7d. during the whole of 1925, the fathoms per machine shift amounting to 2·39 last year, against 1·76 in 1924. The efficiency was still further raised during the first four months of 1926, the fathomage being increased from 2·39 in 1925 to 2·61, and the cost of breaking reduced from 32s. 7d. to 31s. 1d. per fathom. In April the cost per fathom broken worked out at 29s., the lowest figure yet recorded. All the mines have increased the percentage of stoping done with the jackhammers; for instance, the Geduld reports that at the end of last year 80 per cent. was being done with jackhammers, while the E.R.P.M. reports a similar proportion, against 69 per cent. in 1924. The use of O'Donovan furnaces is also rapidly extending and has resulted in great improvement in the reliability of drill steel and efficiency in the drilling.

Swaziland Railway.

The Union Government proposes to construct a line of railway to the Swaziland border with the object of giving producers of southern Swaziland an outlet to the markets of the world *viâ* Durban. If Swaziland is ultimately incorporated in the Union the line could be extended north to the Ingwavuma River to Komatipoort or westward through the Rooirand to Moolmans. The line will be an extension of the Matubatubaland-Pongola Railway now under construction. It will be 5 miles in length from railway head in Zululand to the terminal point on the Swaziland border, and will cost £67,356, to which the Imperial Government has agreed to make a contribution of £10,000. The result of the building of the railway will be much more important than its small length would indicate, as careful investigation by the Railway Board has established the fact that the area which will be served by the extension is of high potential value. The revenue is expected to show a surplus of £3173 for the first year.

Double-deck Railway Coach.

A member of the mechanical staff of the Salt River Works of the Railway Administration, Mr. Oscar Hulse, has invented a double-decked suburban passenger coach which is a new departure in railway coach construction, and has been patented in South Africa, Great Britain, United States, and other countries. An experimental coach is to be built at the Salt River workshops, where the detailed designing of the vehicle has been carried out by Mr. A. L. Ramsay.

The length of the coach will be 62ft. 6in., the height from the rail level 12ft. 8in., and the width 9ft. 1½in. In outward appearance the vehicle will resemble a modern suburban coach, except that it will be slightly higher and between the two sets of wheel tracks the body frame will be sunk below the level of the wheel axles, thus permitting of two passenger-carrying decks being provided instead of one. Access to the upper decks will be by means of stairways leading from the normal floor level to which passengers ordinarily step from the station platform.

Seating accommodation on both decks will be arranged longitudinally. On the lower deck the seats will be placed on each side of a central corridor, and on the upper deck they will be back to back, the corridors being on the outside of the seats, that is, between the seats and the side walls. The requisite walking height for the lower-deck corridor will be obtained by utilising the dome space available underneath the two back-to-back rows of seats on the upper deck, while on the upper deck the floors of the two corridors will be situated over the seating accommodation of the lower deck at a level which gives sufficient walking height. Seating accommodation will also be provided in the vestibules or single-deck portion. This will conform to the arrangement of seats at the ends of existing modern suburban coaches. Entrance to the coach will be through the vestibules by doorways leading from the normal floor level to which passengers ordinarily step from station platforms. Hand rails are to be provided on both upper and lower decks for the convenience, when necessary, of standing passengers. The upper deck will seat 48 passengers, the lower 48, and the vestibules 24, a total of 120 passengers. The maximum seating capacity of a first-class corridor coach of ordinary construction is 72 passengers.

The Port of Antwerp.*

By Monsieur K. BOLLENGIER, Chief Engineer and Director of Harbour Works.

THE port of Antwerp is situated on the right bank of the Scheldt, at about 90 kilomes.—56 miles—from the mouth of the river at Flushing.

The Scheldt is a river in which the tide is felt as far as Ghentbrugge—above the City of Ghent—where the first locks are situated. The mean range of tide at Antwerp is 4·20 m.—13ft. 9in. Vessels drawing 33ft. of water can remain moored to the wharves at low water, and the Belgenland, a ship of 27,000 tons, can easily steam up the river as far as Antwerp.

For descriptive purposes the port of Antwerp may be

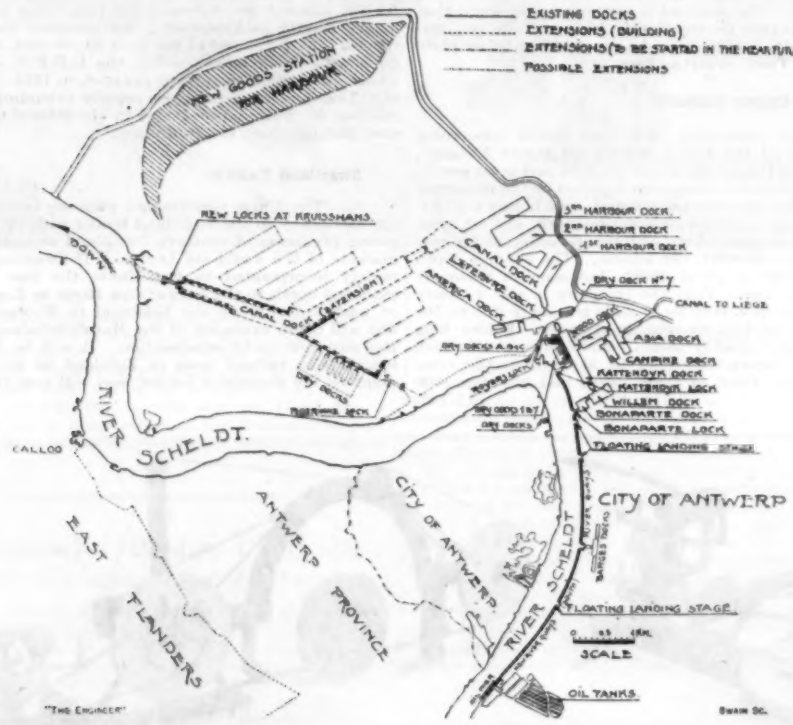


FIG. 1—GENERAL PLAN OF THE PORT OF ANTWERP

said to consist of two distinct sections—first, the installations along the river—quays and oil and petrol depôts; and secondly, the closed basins to the north of the town. A general plan of the port works is reproduced in Fig. 1.

River Quays and New Southern River Quays.—The alignment of the right bank of the river was not always as regular as it is at the present time, and formerly vessels were moored at quays and piers where the depth of water was comperatively small, conditions which would not suit modern shipping requirements. Canals, called *vlieten*, opened out in the Scheldt at various points, and in these canals the barges were aground at very low tide. The town sewers also had their outlet in these canals.

In 1874 the State undertook to reconstruct the quays over a length of 3500 m.—over 2 miles—in a straight line, to acquire the necessary land for the purpose, and to carry out the earthworks so as to give the quays a width of at least 100 m.—328ft. The State guaranteed a draught of at least 8 m.—25ft. 3in.—at the quay walls at low tide. The City, on the other hand, undertook to fit out the quays with the necessary cranes, sheds, passenger stations, &c., and to do the paving. The City agreed, however, to take charge of the maintenance of the whole equipment, whether originally carried out by the State or by the City, except in regard to any partial reconstruction of, or heavy repair to, the quay walls, which work was to fall to the State. The Southern Lighterage Basins were built to replace the *vlieten*. The building of the Scheldt quay walls formed one of the first occasions when compressed air caissons were used on a large scale.

The Scheldt quays became insufficient in course of time, and a further agreement was made in 1895 between the State and the City with a view to the construction of the New Southern Quays over a length of 2000 m.

Oil and Petrol Depôts.—About twenty years ago the City decided to remove the oil and petrol depôts from the vicinity of the America Dock, and the installations were transferred to a tract of land which it purchased for the purpose at the end of the New Southern Quays. The land in question has an area of about 65 hectares—160 acres—and has been mostly levelled down to about 3·5 m. —11ft. 6in.—below the quay wall.

The installation comprises no less than 181 tanks, having a total capacity of about 261,000 cubic metres—57 million gallons—of naphtha, petrol, lubricating oil, &c.; the storehouses and fitting shops cover an area of about 60,000 square metres—645,000 square feet.

Northern Docks.—The wet docks, approached through lock gates, are situated to the north of the City. The water level is practically stationary, being about 60 cm. below mean high water of the river Scheldt. The docks, between which there is free communication, are thirteen in number, and their principal characteristics are given in the table below.

Sheds.—The City places its sheds at the disposal of shipowners for the temporary storage of goods for a few days before shipment, or for a few days after unloading. The sheds cover a total area of about 58 hectares—143 acres.

Cranes.—The port is fully equipped with hydraulic and electric cranes. The cranes, as a rule, are hydraulic from the New Southern Quays to the America and Lefèbvre Docks, and electric to the north of these docks. The cranes of the America and Lefèbvre Docks are partly hydraulic and partly electric. The electric cranes take either direct or alternating current. The direct current is supplied at 550 volts by converter sets taking a 6500-volt alternating current. The alternating-current cranes take a 270 to 300-volt current obtained by transforming down the 6500-volt current.

Floating Equipment.—The provision of large-sized docks has greatly facilitated the direct transhipment of goods from vessels to barges and *vice versâ*, the vessels being moored to buoys. This method of working has led to the installation of a powerful floating equipment, embracing floating cranes, grain elevators, tugs and dredgers.

Dry Docks.—The port of Antwerp has nine dry docks, two of which, on the left bank of the river, belong to a private company, whilst the seven others are the property of the City. Six of the latter open into the Kattendijk Dock. One is 163·55 m.—536ft.—in length, another has a length of 73·80 m.—242ft.—a third is 52·18 m.—171ft. —long, whilst the three others have a length of 139·65 m. —357ft.

The No. 7 dry dock is at the eastern quay of the Lefèbvre Dock. It has an effective length of 220 m.—721ft.—width, 26 m.—85ft.—height of water on the sills, 8·80 m. —28ft. 10in. Dewatering is by a set of three centrifugal pumps, the capacity of which is 60,000 cubic metres—13 million gallons—in one and three-quarter hours. This dry dock will be able to take the steamship Belgenland as soon as the Kruisschans Lock is completed.

The characteristic features of the dry docks Nos. 1 to 7 are shown in Fig. 2.

The number of dry docks being now insufficient, the City has decided to build three others at the western quay of the Kattendijk Dock, to complete the series of dry docks Nos. 1 to 6 already existing in that part of the port. These docks are marked by the letters A, B and C in Fig. 2. The work will be put up for tender on August 3rd next.

The dry docks A and B are to have a length of at least 150 m.—492ft.—and that marked C a length of at least 100 m.—328ft.

A new pumping station is to be built at the same time capable of contributing to the dewatering of the existing dry docks Nos. 1 to 6.

Working and Administration of the Port.—The quays and their pontoons have a total developed length of 27·5 kiloms.—17 miles—the water area being 155 hectares—383 acres—leaving out the river area. The wharve platforms have an area of 270 hectares—667 acres—of which 58 hectares—143 acres—are covered by sheds and other buildings. There are at least 181 reservoirs on the oil and petrol depôts, containing about 260,000 cubic metres—57 million gallons—of naphtha, petrol, and oils.

The whole plant belongs to the City, except the quay walls, which were built by the State, but were equipped by the City—cranes, sheds, &c. The working is under the supervision of the City, which takes the necessary steps for the development and the further equipment of the port, draws up the scales of charges, lets the sheds, cranes, &c. The decisions arrived at by the City Council are subject to approval by the Permanent Committee of the Provincial Council as provided by law.

The City of Antwerp operates the port under the supervision of its officials with a view to prevent the formation of monopolies. The loading, unloading, and repairing of ships are not carried out by the City, whose intervention in these matters is limited to placing at the disposal of the parties interested the necessary apparatus and appliances against payment of the tariff charges.

The interested parties select their own workmen. The handling of the goods on the wharves, their transport and storage, are generally, but not of necessity, carried out by the "Nations," viz., co-operative societies constituted for this purpose. The handling of goods on board ship is generally in charge of the stevedores, assisted by special gangs of lightermen. The control of the port is in the hands of the Burgomasters and Aldermen Committee, who,

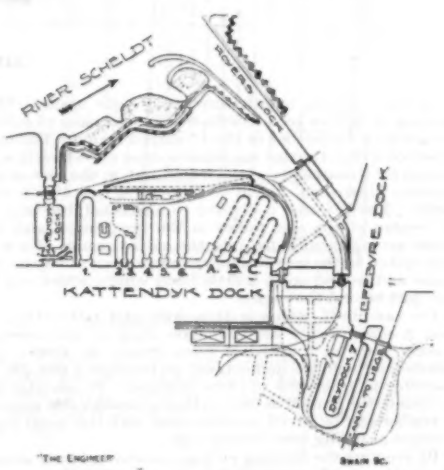


FIG. 2—PLAN SHOWING POSITIONS OF DRY DOCKS

among their other duties, have charge of administering the port within the limits drawn up by the City Council. The technical departments, the port and wharf services, are directly under the jurisdiction of this Committee. The administration of the Scheldt, pilotage, buoyage, in short, all that concerns the river itself, is under the supervision of the State.

Railways.—The working of the railways to and from the ships is carried out by the Belgian State Railways Board, which lays down the lines and has charge of their maintenance.

The total length of the tracks around the port and in the marshalling depôts exceeds 400 kiloms.—about 250 miles—equal, therefore, to about 800 kiloms.—500 miles—of rails.

All the northern basins are to be served later by a station now in course of construction, on land belonging to the Oorderen Borough; this is to be about 5 kiloms.—3 miles—in length, over an average breadth of 1·5 kiloms.—about 1 mile.

Traffic of the Port of Antwerp.—In 1900, 5244 sea-going ships, with an entrance total of 6,691,791 tons, Moorsom, entered the port of Antwerp. In 1913 the number of ships was 7056, with a total tonnage of 14,146,819. This figure was surpassed in 1922 and in 1925 9971 ships, representing a total of 20,201,628 tons, entered the port.

Extension Works.—The second and third harbour docks, and the corresponding part of the Canal Dock, were hardly completed when the war broke out in 1914. The equipping of the quays was not begun practically until after the war, and is just about finished now.

Notwithstanding the great length of quays and the

Table of Particulars of Docks.

Name of dock.	Length.	Breadth.	Water Surface	Quayage length.	Bottom below datum.	Depth of water.§
	Metres.	Metres.	Sq. metres.	Metres.	Metres.	Metres.
Bonaparte Dock	150	170	25,500	650	— 2·78	6·83
William Dock	380	150	57,000	1,010	— 2·78	6·83
Junction Dock	85	50	4,250	230	— 3·33	7·38
Kattendijk Dock	960	140	134,400	1,980	— 3·33	7·38
Kattendijk Lock	110	70	7,700	320	— 3·33	7·38
Wood Dock	530	137·50	72,900	1,320	— 4·53	8·58
Campine Dock	343·50	160·50	55,150	1,010	— 4·53	8·58
Asia Dock	677·60	102·60	69,530	1,555	— 4·53	8·58
Junction Dock	115	50	5,750	290	— 3·33	7·38
Lefèbvre Dock†	—	—	100,000	1,770	— 5·25	9·30
America Dock†	—	—	67,500	1,545	— 5·25	9·30
Canal Dock	1,655	250	413,750	2,950	−6·25 to −7·40	10·30 to 11·45
First Harbour Dock	525	180	94,500	1,480	— 5·25	9·30
Second Harbour Dock‡	$\frac{700 + 780}{2}$	200	148,000	1,680	— 6·45	10·50
Third Harbour Dock‡	$\frac{780 + 1,140}{2}$	200	192,000	2,120	— 7·40	11·45
Basin for Barges†	—	—	72,000	1,317	— 0·50	4·55

All rectangular except † Polygonal and ‡ Trapezoidal. § Water level is + 4·05 m. above datum.

* Read at the summer meetings of the sixty-seventh session of the Institution of Naval Architects, held in Belgium, June 25th, 1926. Abridged.

space behind them, and the immense water surface, these basins are actually becoming insufficient, so that large extensions are in contemplation. Even before the war started, it had been decided to extend the Canal Dock between the third harbour dock and the place called "Kruisschans," where admission to the river will be given by a new large lock for sea-going vessels. These lock-works, begun in 1914, were held up during the war, and started again at its conclusion. They are now approaching completion.

The new piece of canal dock will have a length of about 6·1 kiloms., breadth of 300 m. to 400 m., and a depth of water of 11·50 m. The quay walls will extend for the entire length except where new docks will later open into the Canal Dock, but temporary embankments will be provided at these places.

The Kruisschans lock will have two sliding gates at each end of the lock, the effective length between the extreme gates being 270 m., width 35 m., and the depth of water on the sills 10·50 m.—about—at low tide and about 15 m. at high tide.

To the canal dock extension other harbour docks will eventually be attached, and two of these docks will be begun very shortly, situated between the Scheldt and the Canal Dock. A new lock, the "Boerinne" Lock, will join up these docks with the river.

When these new works are completed the Port of Antwerp will own 45 kiloms.—28 miles.—of quayage, and a total dock area of at least 500 hectares—1250 acres.

The Kirin-Tunghua Railway.

THE following notes on the railway which it is proposed to construct between Kirin and Tunghua, in Manchuria, are taken from the official *Bulletin* of the Chinese Government. The line, it should be pointed out, will form an important extension of the Changchun-Kirin branch of the South Manchuria Railway.

The South Manchuria Railway Company is the contractor for the proposed extension of the Changchun-Kirin Railway to Tunghua, and surveys are already in progress. Changchun is the northern terminus of the main line of the S.M.R., but is, of course, connected with the Trans-Siberian Railway *viâ* Harbin.

An agreement for the construction of the Kirin-Tunghua extension was concluded with the Chinese Government as far back as 1909 by a group of three Japanese banks, the Industrial Bank, the Bank of Chosen, and the Bank of Taiwan. The scheme remained dormant for years, until, in fact, the S.M.R. arranged with the banks mentioned to take over their interests. Subsequently, in 1925, an agreement was reached with the Chinese Government whereby the S.M.R. undertook to construct the line as contractor, the railway to be and remain part of the Chinese line running from Changchun to Kirin. This contract was repudiated in the autumn of 1925 when Marshal Chang Tso-lin's influence was withdrawn from the Peking Government, but later its legality was established.

The contractors estimate the distance of the new line at 130 miles, costing Yen 18,000,000, excluding tunnel work. The contract calls for the completion of the undertaking within two years, but, owing to the mountainous nature of the country, it is doubtful whether it can be completed in that time.

Virgin forests aggregating a thousand square li lie between the two termini. Moreover, according to one investigation, only about a fifth of the cultivable land is under cultivation. A Japanese surveyor is authority for the statement that over 200,000 piculs of soya beans and half a million piculs of wheat and other cereals are produced yearly in the four districts, Kirin, Hwatien, Erhmu and Tunghua; great numbers of horses, cattle and pigs are also reared in the country.

The surveying parties are divided into four sections, each section comprising 15 members under the escort of 25 Chinese soldiers. Section 1 is to look after the 30-mile section between Kirin and Ehomu; section 2, the 25-mile section between Ehomu and Imaho; section 3, the 35-mile section between Imaho and Tashaho; section 4, the 40-mile section between Tashaho and Tunghua.

The most difficult sections from a technical standpoint are the 25-mile section between Ehomu and Imaho and the 30-mile section running from north to south on both sides of the boundary line of section 3 and section 4, which are included in the forest zones.

In particular, the railway bridge over the Sungari and the three tunnels to pierce Laoyehling and Weihuling present the pieces of work of greatest importance on the whole line. The Sungari near Kirin is 450 m. wide. Bridge piers are to be constructed at an interval of 48 m. All other bridges will be wooden.

The total lengths of the three tunnels will be 3300 m. All the hills being of granite formation, the excavation work will be very laborious, and in order to save money as well as time, the latest rock-drilling machines will be used. For the provisional tunnels, the gradient will be 1/40, to be reduced to 1/80 when the permanent tunnels are excavated.

The Tunghua line has a peculiar advantage over the Taonan-Angangchi line in that any amount of timber is available along the route, while concrete-making materials are found everywhere. This will save considerable hauling and expense. Again, coal is obtainable near Chiaoho, and when brick is made available on the spot, the only building materials to be imported will be cement and rails.

NEW CANADIAN PACIFIC CARGO SHIPS.—Before leaving for Canada on Saturday last, Mr. E. W. Beatty, the president of the Canadian Pacific Railway, announced that three cargo ships had been ordered for the company's London–Montreal service from Barclay, Curle and Co., Ltd., Glasgow, William Denny and Brothers, Ltd., Dumbarton, and Sir W. G. Armstrong, Whitworth and Co., Ltd., Walker-on-Tyne, respectively. The new ships will have a deadweight tonnage of about 10,000, and will be propelled by geared turbines working at a pressure of 250 lb. per square inch. A combination of water-tube and Scotch boilers with mechanical stokers will be fitted. The ships are to be delivered in about one year's time. For the time being, the contracts for the other two ships are to be left in abeyance.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Depression Expanding.

THE ninth week of the coal stoppage is marked by an extension of the depression in industry. Dwindling stocks of fuel and materials are having their inevitable effect on the Midland and Staffordshire industries, and the difficulties of carrying on in the limited fashion which has been necessary for some weeks past become steadily worse with the passage of time and the absence of a settlement of the coal dispute. The majority of trades have now become seriously affected, though there are exceptions where work is proceeding on almost normal lines. Work in the engineering branches and in the factories where metals are turned into articles of world-wide service has been kept going surprisingly well considering the paralysis which has disabled many basic industries. But with smelting plants, melting furnaces, foundries and rolling mills standing idle productive activity in the finishing trades is necessarily declining.

Market Situation.

The situation in the iron and steel trades of this district so far as output and consumption are concerned is much the same as it was a week ago. In the main business is at a standstill, and in almost every department the limited supplies available from stock are being rapidly absorbed, and for what little remains increased prices are asked. Under these circumstances more attention is being paid to foreign supplies, for only the shortage of raw material stands between some of the finishing trades and continued production. On 'Change in Birmingham to-day—Thursday—it was reported that Belgian pig iron had been ordered by local founders for delivery next month. Continental sheet bars were also ordered to enable rolling mills which still possess fuel, or the means of procuring it, to keep going. Foreign semis generally were more largely inquired for, the makers of billets and blooms and sheet bars in this country having nothing to offer.

Staffordshire Iron Trade.

Stagnation has overtaken the finished iron trade of South Staffordshire. The mills are idle and there is little, if any, material now left in stock to offer on the market. Lancashire makers, too, have nothing to offer, and consumers must perforce secure necessary supplies from continental sources. They are anxious, however, not to commit themselves far ahead, foreign bars being far from satisfactory for many purposes.

Steel Conditions.

Steel furnaces in the Midlands are out of action and there is little prospect of a resumption of operations for some time to come, even if a settlement were found to the coal dispute to-morrow. A fair number of re-rolling mills are running in this district, use being made to a certain extent of residue fuel from the mounds, occasionally supplemented by coal from the pits which have restarted in the district, and in some cases oil or tar is being introduced. Inconsiderable quantities of steel strip, small bars, sections, joists, and plates are still being marketed. Sections and joists, which could be bought three weeks or so ago at £7 2s. 6d.—though quotations were generally higher—now command a full £7 7s. 6d. Sections are very scarce, the sources of supply having become fewer. Four or five mills in the Birmingham area are still rolling strip, small bars, and bedstead angles. Plates, ¼in. thick and over, are £8 2s. 6d., whereas they were formerly 5s. less. Steel plates are obtainable in small quantities from Clydeside and South Wales, but most of those which reach this district are going into the tube works, which have heavy contracts on hand. A few mills are producing billets from fairly good supplies of ingots in stock when the stoppage occurred. Belgian angles are about £6 and joists £5 16s. to £5 17s. A variety of steel materials are on offer, but they often turn out to be unsuitable, especially in the matter of size, and in ordinary times would be ignored. A certain amount of coal was reported to be available for works in the Midland district, but at prices which prevented its being of any use to the steel makers.

Foundrymen and Foreign Pig Iron.

Famine conditions are developing in pig iron. All the furnaces are out of action in the Midland district and ordinary Northamptonshire and Derbyshire brands are sold out. It is difficult also to get North Staffordshire iron, and foundries have to make the best use they can of any class of material available. The pig iron stocks which have been keenly sought after during the strike are now practically all disposed of, and some of the foundries are within sight of stoppage for lack of casting material. The foundries of the district are, for the most part, at work. They have, so far, been kept going fairly well, but most of them are now acutely feeling the stringency and the end is definitely nearer. Some foreign pig iron has been on offer this week and Midland founders, though they consider it unsuitable for many requirements, have been induced to purchase it by reason of the fact that the price at which it can be delivered here from Belgium compares favourably with the rates demanded for the remnant of pig left at Midland furnaces. Founders can get Belgian supplies delivered at about £4 8s. 6d. They do not want to enter into commitments which might exceed the exigencies of the crisis, however. Derbyshire and Northamptonshire No. 3 are no longer available and all the foundry numbers appear to have been exhausted, or very nearly so. The high-silicon grades which were offered a week ago have passed into consumption. Derbyshire forge has been quoted at £3 5s. at furnaces, but foundrymen fight shy of it. Some Cleveland No. 1 has been quoted at £4 5s. at furnaces, which would mean just over £5 here. East Coast hematite, which can be bought at £3 16s. to £3 18s. at furnaces, is being more extensively used. So far, coke supplies have been generally sufficient. Furnace owners who have insufficient coke to run their furnaces have been willing to dispose of quantities to ironfounders and others to meet their emergencies. Though this class of fuel is ordinarily considered unsuitable, the founders are able to carry through their casting operations, occasionally with the aid of gas coke, which can still be bought.

Galvanised Sheet Values.

The principal galvanised sheet rolling mills are at a standstill, but orders are being regularly booked with all the principal consumers. Twenty-four gauge corrugated sheets are offered by some makers at £16 to £16 5s. for delivery after resumption. At mills which are still running quotations for prompt lots range from £16 10s. to £17. A local galvanised sheet-making firm last week appealed for business, stating that four-fifths of its plant was in operation. The firm, it is understood, is in a position to accept orders for 30-gauge and lighter sheets, and is able to give delivery within fourteen days. The price asked is £17 for 24-gauge sheets. It was pointed out by the firm that there would be a big demand for galvanised sheets as soon as the coal difficulty was got rid of and that as most of the works had full order books it was unlikely that prices would be reduced and quick deliveries would be practically impossible. The case is considered a remarkable example of the successful overcoming of difficulties, and the view taken of prospects in connection with the sheet trade is probably well founded.

Coal Mining.

The pits which have been reopened here and there in the Midland area, as reported in my last letter, are making a somewhat larger output. In one or two instances practically the full complement of workers is available. The coal they are raising is a welcome relief, though little of it is available for the heavy industries of the Black Country. The number of men who have returned to work is somewhat larger and increases day by day, but the lead given at the pits where conciliation prevails has not been widely followed. In the Warwickshire coalfield thirteen collieries are working, between 1600 and 1700 men being engaged. South Derbyshire colliery owners have offered to reopen pits on an eight hours' day basis at practically April rates. Though the response has not been great, sufficient men have signed on to justify the reopening of the Hall's Colliery Company's three pits and the Granville Colliery. At Hall's Swadlincote pit all the deputies have resumed. Industrialists in this area are now seriously studying negotiations for supplies of foreign coal, and it is reported this week that some fairly substantial consignments of coal from Silesia came into the Midlands last week. Manufacturers are determined to keep going as long as it is humanly possible, and are availing themselves, not only of foreign coal, but also of continental raw materials.

Birmingham's Progress in Electricity.

The additional use being made in Birmingham and district of electricity for all purposes is amply proved by the fact that the revenue from all sources was £1,323,831, an increase of £141,209, or 12 per cent. on the previous year's figures. On the other hand, the working expenditure, at £727,537, shows a decrease of £9318 compared with last year, although 16 per cent. more business had been dealt with. The cost per unit sold has decreased 15 per cent. on the average. Owing to the demands made upon its generating plant and the probability that by the winter of 1928–9 the margin will be less than is considered sufficient properly to safeguard the service, the Birmingham Electric Supply Department is asking the City Council to approve of an expenditure of £1,336,400 on the first section of a new power station on the Hams Hall estate, comprising 60,000 kilowatts of plant. An additional sum of £35,000 required for housing the staff and workmen makes a total of £1,371,400, which would have to be provided in instalments over a period of four years to June, 1930. The capacity of the complete station will be 210,000 kilowatts, and the estimated total cost amounts to £3,200,000.

The Electricity Bill.

The Council of the Birmingham Chamber of Commerce has some criticisms to level at the Electricity (Supply) Bill and it holds that certain modifications of the Government's proposals should be made. It feels that in the case of manufacturers receiving a public supply of electrical power it would be a great hardship if they were required to change their plant without compensation, and the General Purposes Committee of the Chamber recommends that representation should be made to the Ministry of Transport urging the Government to modify its present proposals. It is stated that during the period of change from one system to the other a great many of the manufacturing metal trades would be entirely stopped for two months, which would be a most serious thing. The Chamber has decided, in the interest of local manufacturers, to act in accordance with its Committee's recommendation.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE engineering industries are carrying on as best they can under the difficulties of raw material supplies, and some are getting through better than others, although there is no doubt that the situation is one of very great difficulty for all of them. In the case of the foundry departments, of course, the fuel problem is supreme, for even if iron were easily obtainable at normal prices there are many foundries that are entirely without fuel. As far as possible, firms are using oil in place of coal, and this, in addition to electric power supplies, is helping matters considerably. On the other hand, however, the effects of the stoppage in other directions—for example,

in the holding up of business that would otherwise be placed—is resulting in short-time operations at many works. As has been the case for some time now, manufacturers of electrical plant and machinery are perhaps the most fortunately situated from the point of view of work in hand. Constructional engineers also have several big contracts to execute, but in this case much of the work is held up primarily because of the difficulty of getting hold of supplies of heavy steel work. Makers of textile plant are not in a particularly good position, for in view of the state of the cotton industry a poor home market is to be expected. On the export side orders are being received, but they are very considerably below normal. Manufacturers of machine tools are also, in many instances, employed at much below capacity.

Non-ferrous Metals.

The movements of the non-ferrous metals during the past week have been variable. Whilst tin has more than held its own compared with the previous week, copper and lead have lost ground, and spelter has been barely steady. Mainly under the influence of continued good buying on United States account, and an improvement in European interest in the metal, tin acquired additional strength, although at the time of writing there are signs of reduced activity and prices have fallen away slightly from the highest. Stocks at English port warehouses are somewhat heavier than they were a week ago, but not to such an extent as to make any appreciable difference to the statistical strength of the market. The domestic buying of copper is less active, notwithstanding purchases by British cable makers, whilst the demand from European consumers is on a smaller scale. Under the circumstances it is surprising, if anything, that the loss in values has not been greater than is actually the case. Spelter has been fairly steady in spite of the relatively slow inquiry for the metal, and it is believed that the position in America remains a strong one. Buying interest in lead has not been particularly keen, either on home or continental account, and the position at the moment is less healthy than it was at this time last week.

Iron.

The chief point of interest in an otherwise featureless market is the steady advance week by week, in some cases almost daily, in the quotations for pig iron. This does not apply to every kind of iron, however, for Scottish No. 3, which is available for early delivery in small quantities at 97s. 6d. to 98s. per ton delivered, has not risen very much compared with the quotations ruling on that market just before the general stoppage, the figure then being from 94s. to 95s. per ton delivered Manchester or equal distance. The same applies to hematites, East and West Coast makes being offered here at up to 95s. In the case of Derbyshire and Staffordshire No. 3 pig irons, however, the advance has been much more serious, and at 93s. 6d. and 97s. per ton delivered prices are in the neighbourhood of 20s. a ton more than they were at the end of April. In these cases there is no doubt that the high prices are dictated by the extreme scarcity of available supplies, although it is curious, notwithstanding, how these small odd lots continue to make their appearance on the market. A limited quantity of Middlesbrough No. 3 has been quoted at about 97s. 6d. per ton, whilst silicon irons range from about 94s. to 100s. per ton, according to analysis. The position of bar iron shows little material alteration, and the higher prices which came into effect at the beginning of last week remain unchanged, Lancashire Crown bars being quoted at £11 10s. per ton and seconds at £10 5s., including delivery into this area. The demand for manufactured iron is on a reduced scale compared with what it was some weeks ago, but the net result of the cessation of production at many works since the beginning of May is that stocks have been reduced to a very considerable extent.

Steel.

It is still the case in the steel market that some of the rolling mills are not prepared to accept forward business at the recently increased prices, although, I think, in most cases they are. During the present week there has been quite a good inquiry for plates and bars, and indeed for most classes of steel, and nearly every firm reports good order books, much of the business representing specifications against contracts entered into before the stoppage, waiting to be dealt with. Several inquiries for materials for the locomotive industry have been reported during the past few days. Locomotive plates are quoted at £11 5s. to £11 10s. per ton, bars at £8 10s., joists and sections at £7 7s. 6d., and ship and tank plates at £8 2s. 6d., delivered Manchester or equal. Galvanised sheets have advanced here to £16 10s. per ton f.o.b. for the usual Bombay and Calcutta specifications, but with the exception of one or two small orders there has been little of importance passing. Stocks of continental steels in Manchester are pretty good and for them there is a quietly steady demand. For direct shipment from the Continent, however, business is moderate. Sheet bars are firm at up to £5 7s. 6d. per ton delivered Manchester, for net cash against documents, with Siemens plates unchanged at £6 7s. 6d., ordinary plates at £5 17s. 6d. to £6, joists at £5 12s. 6d., and sections at about £5 17s. 6d.

Scrap.

There is virtually no demand for iron and steel scrap and prices are purely nominal in view of the very heavy stocks. Non-ferrous metal scrap is quiet, but values keep fairly steady at about £60 for heavy copper, £50 for braziery copper, £28 to £29 for lead, £24 for zinc, £52 for gun-metal, and £85 for cast aluminium, for graded qualities, delivered to users' works.

BARROW-IN-FURNESS.

Hematites.

The holding up of trade in the smelting of hematite pig iron still continues, and masters and men are just watching events with the hope that the long stoppage will soon come to an end. There can be no restart of iron making until coal and coke supplies are available. When trade was slacking off prior to the calling of the general strike, iron was run into store, and some of it has been sold to ironfounders, but the business done has really been quite small. No shipments to overseas are noted.

Iron Ore.

Iron ore is being raised in both North Lancashire and Cumberland, but most of the iron ore pits are closed down. There is no trade being done on local account, but a shipment of Furness ore has been made from Barrow to Treport, France.

Steel.

The business being done in main steel products just now is at a standstill, and there is complete idleness at the works at both Barrow and Workington. At both places fair orders are held for home and overseas buyers.

Shipbuilding and Engineering.

These trades continue to keep employed in every department, but there are no new features to report this week. It is noted that Vickers Ltd. has made arrangements to manufacture the M.A.N. heavy oil and other engines.

SHEFFIELD.

(From our own Correspondent.)

Figures of Steel Production.

THE returns of steel production for April, which have just been issued, show that the output of ingots and castings in the Sheffield district was 84,200 tons, including 38,100 tons of acid and 40,700 tons of basic. As compared with March, the total showed a drop of nearly 20,000 tons, but this was accounted for by the Easter holidays. When the figures for May appear, they will be very poor indeed, as open-hearth production was practically suspended when the general strike began, and has remained in that state ever since. There is not much chance of any resumption until the coal strike ends. Great quantities of coal are used by the furnaces, and, although some foreign fuel has come into Sheffield for various other departments, it is too expensive to be employed on a large scale.

The Manufacturing Departments.

Although no steel is being produced in the district at present, the manufacturing and engineering departments are still succeeding in carrying on to a considerable extent, thanks to stocks of material which were on hand, to outcrop coal, gas and electric power. Local works are now receiving regular deliveries of outcrop coal, which, although of inferior quality and costing from 30s. to 40s. per ton, enables firms to maintain some manufacturing operations and to complete orders for finished goods. The extent to which the works have been able to continue is really very striking. The unemployment figures have run up to about 40,000, but this is less than half the total which was registered during the eighth week of the 1921 strike. A considerable amount of the motive power used at Sheffield works is derived from gas and electricity, the supplies of which have been well maintained. The gas company announces that it has still sufficient coal supplies to last for a few weeks. It may drop the quality of gas slightly in order to conserve coal supplies, but it will not introduce rationing at present. It appeals to consumers, however, not to use gas extravagantly. The electric supply department will also be able to carry on for some time with the exercise of care, but it likewise advises the utmost economy. The situation with regard to steel for working-up purposes is becoming serious, as stocks are running very low. For most local purposes, continental steel is not good enough. One Sheffield firm, however, has been compelled, owing to the failure of home supplies, to place an order for steel plates in Germany.

Spanish Railway Work.

Among the countries which have large schemes of railway improvement before them is Spain, and if Sheffield can obtain any considerable share of the work proposed to be carried out there its industries will benefit considerably. It is estimated that no less than £24,000,000 is to be spent in constructing new railway lines and improving the equipment of the railways. One of the requirements is 250 locomotives, while the initial orders will also include considerable quantities of rolling stock, among them being 9000 covered wagons and a number of open wagons. Sheffield has already had experience of supplying very satisfactory locomotives to Spain. A few years ago the Yorkshire Engine Company built a fast passenger locomotive of an entirely new type for use on the Northern Railways of Spain. In working order, the weight of the engine and tender was nearly 137 tons. At the time of construction the engine was one of the largest ever built in this country. So satisfactory did it prove in service that fifteen duplicate engines were ordered.

Two Company Reports.

The report of the Stanton Ironworks Company, which has been published during the past week, shows that the company had a successful year, the profit amounting to £237,843. The dividend is 10 per cent. free of tax; £50,000 is placed to reserve for depreciation of new works and £148,700 carried forward. The company is in the fortunate position of producing several valuable specialities which are in growing demand and yield a profit. Another report of the week is that of Davy Brothers, Ltd., the well-known Sheffield firm of engineers. Their experience of the past year has been similar to that of the year before, and they have to record a loss of £12,415. The directors express regret that the difficulties of the industrial situation have resulted in an adverse balance. They state that the scarcity of orders from the company's steel works' clientele, and the intense competition for such work as has been obtainable, has had the effect of depressing prices below cost, and, in addition, there has not been a sufficient volume of work to keep the machinery and plant adequately occupied. The directors strike a note of hope, as they say that "there are not lacking indications that a renewal of demand for the company's products would follow the removal of the present unfavourable circumstances."

Nottingham as a Seaport.

The city of Nottingham, 96 miles away from the sea at Hull, is now, or very soon will be, a seaport so far as its accessibility by barges of 120 tons is concerned. All that remains to be done, before this desirable consummation is actually reached, is the dredging of certain parts of the river Trent, in order to ensure the requisite depth of water at all points. What has been done recently is the construction of four locks on the river, the last of which was opened by Mr. Neville Chamberlain, Minister of Health, last week. These locks have all been made by the Corporation of Nottingham on the 23-mile stretch of the river between Newark and Nottingham. The 73 miles between Hull and Newark were improved some years ago. The four new locks are at Holme Pierrpont, Stoke Bardolph, Gunthorpe, and Hazleford. The first pair, which necessitated the mixing and laying of 28,000 tons of concrete, cost £150,000, and the second pair £200,000. The Government, through the Unemployment Grants Committee, is contributing 50 per cent. of the payments in respect of sinking fund and interest for fifteen years. The length of each lock is about 160ft. by 30ft. wide, and each is capable of passing through three 120-ton barges and a tug in one operation. The scheme will afford considerable trade advantages to Nottingham, Newark, Gainsborough, and the agricultural district *en route*. It was the Hazleford lock which Mr. Neville Chamberlain opened, and he spoke of the ceremony as a sign of the completion of the most important development in inland navigation that had been made since the opening of the Manchester Ship Canal.

Cutlery and Plate.

There is little fresh to say about the condition of the cutlery and plate trades, which remain in the same unsatisfactory state as has been reported in recent letters. There are a good many contracts about for the equipment of ships, hotels and restaurants, but the ordinary shopkeeping demand is at a low level. The export trade is fairly well maintained, but the tendency of several markets to take an increasing proportion of goods of the cheaper grades is still noticeable. The interesting announcement is made that the British Oneida Community, Ltd., an offshoot of the well-known New York Oneida Community, has acquired works in Sheffield. The American company is a well-known silver and electro-plate house, and the local premises will probably be used for the finishing processes of its plate and as a depôt for the firm's goods.

Merits of Asphalt Roads.

During the last few years large stretches of rolled asphalt road have been laid by the Sheffield Corporation, under the supervision of Mr. W. J. Hadfield, city surveyor, and that gentleman, at the meeting of the Institution of Municipal and County Engineers at Bristol last week, read a paper in which he spoke highly of the merits of this method of construction. He said that probably the rolled asphaltic surface, with the right aggregate and a proper proportion of bitumen, afforded the best grip of any smooth pavement. He gave very striking figures as to the small number of accidents occurring in Sheffield, with its 400 miles of highway and 650,000 super yards of asphalt, during six bad months of last winter. On the question of economy, he said that when he first laid rolled asphalt in 1916 he confined himself to streets of medium traffic, with a few small pieces of heavily trafficked streets, the latter being laid more with the idea of seeing how soon they would wear out than of proving how long they would last. It did not, however, take very long to come to a definite conclusion concerning the wearing qualities of rolled asphalt, and in 1919 about 22,500 super yards were laid, generally in busy streets. Most of this remained and was in good condition to-day.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Industrial Situation.

THERE has been no outstanding development in the industrial situation in the North of England during the past week, and all concerned are still patiently waiting for a settlement of the coal dispute, though even the most optimistic fail to see how there can possibly be a general resumption of work before the middle of August, even should matters be arranged in the course of the next few days. Some are pessimistic enough to predict that no blast-furnaces will be put into operation again until well into the autumn. Certainly it will be impossible for smelting to be resumed until three or four weeks after the termination of the coal trouble, as practically all the coking plants have been allowed to die out. In the meantime, the crippling effect of the coal stoppage becomes daily more serious in the iron and steel industries. Stocks of fuel are rapidly becoming exhausted, and large consumers are faced with having to import supplies or lay more of their plant idle. A number of cargoes of foreign coal have been purchased for use in the Cleveland district, including coking qualities for conversion into coke, to feed the two blast-furnaces that have been kept in operation. Continental competitors are reaping the benefit of the situation. Not only are they capturing foreign markets, some of which may be permanently lost, but they are sending considerable quantities of material into this district.

Cleveland Iron Trade.

Cleveland pig iron prices have taken another upward turn this week. The fact is that supplies are so scarce and the demand so urgent that sellers can almost exact their own terms. It is no exaggeration to say that famine conditions prevail. With the exception of two

furnaces making Cleveland pig iron at the works of Bolckow, Vaughan and Co., Ltd., South Bank, producing plant is inoperative, and stocks are at a very low ebb. The description of Cleveland pig iron most needed is No. 3 quality, but ironmasters have virtually none to offer, while the holdings of merchants have shrunk to quite trifling proportions. As much as 84s. per ton has been paid this week for No. 3 Cleveland pig iron, which represents an advance of 14s. per ton on the pre-strike figure, and other quotations are based on that figure, No. 1 foundry being quoted 86s. 6d.; No. 4 foundry, 83s.; and No. 4 forge, 82s. 6d. per ton. But the market is very unstable. Nobody can tell when the next rise will come, and quotations are all subject to confirmation at the time of acceptance.

Hematite Pig Iron.

Wherever possible, hematite pig iron is being used in the place of Cleveland foundry iron, for not only are supplies available, but the price is relatively low. Still, the scarcity of foundry iron has had its effect on the hematite trade, and prices are inclined to stiffen, some firms quoting up to 80s. per ton for East Coast mixed numbers. However, 79s. is now the more general figure, with No. 1 at 79s. 6d., and at these figures a fair business is being done.

Ironmaking Materials.

There have been no transactions in foreign ore for some time, and 21s. 6d. per ton c.i.f. is purely a nominal figure for best Rubio ore. There are no supplies and no quotations for blast-furnace coke.

Manufactured Iron and Steel.

A supply of fuel having been obtained, there was a partial resumption of operations this week at the Ormesby Rolling Mills, of the Cargo Fleet Iron Company. Two or three other mills are also running, but all other plant is idle. All descriptions of finished material are difficult to secure. Shipbuilders report that deliveries of British plates and angles are unobtainable, and the prices are purely nominal at £7 17s. 6d. and £7 10s. per ton respectively. Foreign ship-plates are being delivered into the district at £6 10s. per ton. Galvanised corrugated sheets are about £16 5s. for 24-gauge, and black sheets £11. Other steel prices are unchanged.

The Coal Trade.

The outlook for the coal trade is no brighter. Operators still hold the view that some weeks will elapse before there is any general renewal of output, and in the meantime, with no prices available, all negotiations are suspended, and idleness on the markets rules supreme. Another colliery in Durham, the Frankland Wood Colliery, resumed operations this week. About fifty-nine men are now back at work on the terms obtaining before the strike.

Ironstone Miners and Holiday Pay.

The Council of the Cleveland Miners' and Quarrymen's Association, at the quarterly meeting at Middlesbrough this week, decided that when work was resumed in the mines, another effort should be made to secure the institution of annual holidays with pay. It was also agreed to make a further request to the owners for a reduction of the prices charged to miners for explosives used in the course of their work.

Order for Cargo Vessel.

Armstrong, Whitworth and Co., Ltd., Walker-on-Tyne, have secured an order from the Canadian Pacific Company for the hull and machinery of a cargo vessel of 10,500-tons deadweight. At present the firm has no vessels being built in its two shipyards, but is completing the battleship Nelson and two cargo boats afloat.

SCOTLAND.

(From our own Correspondent.)

General Situation.

WITH the continuation of the coal strike there has been no chance of any change in the general situation, and the position grows gradually more and more acute. Many, if not most, of the large industrial concerns have already ceased operations, and of those still carrying on, few will reopen after the annual holiday, unless the coal dispute is settled before then. Stocks of fuel are diminishing rapidly, and though perhaps foreign coal might be available, many manufacturers are not prepared to pay the prices asked, consequently a complete stoppage is apparently only a matter of time.

C.P.R. Steamship Contracts.

It had been mentioned already that Clyde shipbuilders expected to participate largely in the contracts for cargo steamers in contemplation by the C.P.R. Company, and of the three orders placed so far two have come to the Clyde. These steamers will be about 10,000 tons each.

Steel and Iron.

So far as actual business is concerned there is no change in the steel trade. Practically all the large works are still closed, and the market is more or less idle. Supplies of plates and sections are becoming very scarce, and prices have been advanced from 5s. to 10s. per ton. Present bookings are light, but since the beginning of the stoppage orders have accumulated to some extent. Steel sheet makers are still comparatively busy, and orders on hand are more than sufficient to outlast their present supplies of coal, and production will soon have to be eased up. A number of the bar iron works are still working, but operations must soon cease under present conditions. The bulk of the output is in re-rolled steel, the price of which is stiffening from day to day. The demand for pig iron is comparatively small, but with most brands scarce or almost unobtainable, quotations are firmer and tending upwards. The production of foundry iron has ceased, and the two furnaces now in operation are making hematite.

Coal.

There has been no change in the coal trade during the past week, and the market continues more or less without interest. The scarcity of industrial fuel is most pronounced. Cargoes of coal are due from abroad, but they will be used chiefly for public utility concerns in the meantime, either to carry on services or to augment stocks. Representations have been made to local gas companies to uphold supplies as far as possible in view of the number of businesses depending on such service, and in many cases foreign fuel will have to be used. House coal has been in quiet demand. In some districts coal has been selling retail at 2s. 9d. to 3s. per cwt. bag, but in other parts, where transit has been difficult, as much as 4s. to 5s. per cwt. bag has been charged.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Outlook.

THE prospects of a settlement of the coal dispute have not appreciably improved during the past week, although rumours have been current of possible developments. No resumption of work is looked for for another fortnight, and the view is still largely held that it is extremely probable that there will be no work throughout the whole of July. The miners in this district have been unusually quiet ever since the suspension of work took place, but the conditions prevailing are very different from those which prevailed when there were previous strikes in South Wales. In all areas the miners' children are being well fed; they have their communal kitchens, and they have relief from the Guardians. From all accounts, no rents or rates are being paid; the workmen's families are not possibly well off, but they are far from starving. In fact, it is freely stated that the children are better fed than under normal conditions. The result is that there is far more contentment than when previous stoppages have occurred in the coalfield. The present stoppage is, in a sense, largely subsidised, and under such circumstances might almost continue indefinitely. The report was current last week-end that a real movement was on foot for a settlement, and that the South Wales coalowners had framed their proposals, which were to come before a full meeting of the members of the Association on Monday. There was, however, no such meeting, while as regards the reported terms to be offered the workmen, they were in the main those which were put forward weeks ago by the owners. No doubt the passing of the Coal Mines Bill will be followed by some action on the part of the coalowners, who may possibly post up at the collieries their terms of work, but it does not follow that that will result in a settlement. Some workmen in different areas may continue to drift back to work, but in South Wales no great hopes are being based on that happening. The probabilities are that the miners in this district will be the last to resume.

Coal Trade and General.

Considering the amount of business which has been done in American coals, particularly, it would appear that the belief is pretty widespread that work in the coalfields of this country is not likely to be seen for a month or more. Chartering of tonnage the end of last week and the early part of this week was very active to lift American coals. The quantity was round about a quarter of a million tons, so that since the commencement of the stoppage tonnage has been taken up to load quite a million and a-half tons of American coals, the bulk of which is for the United Kingdom delivery. Operations have been very brisk in continental coals. Quite a dozen cargoes of coal from Rotterdam, Amsterdam, Antwerp, Ghent, &c., have been brought to the Bristol Channel, and others are to follow. So far as can be ascertained, all the cargoes of Welsh coals, which had been detained at local ports since the commencement of the stoppage, have now been resold to home consumers. The Somerset and Dorset Railway Company bought one cargo which was removed from Barry to Avonmouth for discharge, while the Whitehead Iron and Steel Company, Ltd., of Newport, purchased another of about 1000 tons of semi-bituminous sized coals, the price at which the cargo was transferred being reported to be about 32s. per ton, as against the original price of these coals of about 17s. 6d. So far as business in Welsh coals for shipment when work is resumed in the coalfield, is concerned, it is to all intents and purposes dead. Mention was made last week of the inquiry on behalf of the Egyptian State Railways for 150,000 metric tons of large coals, viz., American, continental or Welsh qualities. This quantity of coal is for shipment during August and September to Alexandria, and must be delivered there at the latest by the middle of October. Tenders have to be at Cairo by July 17th, so that unless our strike troubles are definitely over by that time, it is difficult for firms to quote for Welsh coals, as they can give no undertaking that the fuel will be definitely supplied. That being the case, it is almost certain that the order will go abroad. The Latvian State Railways have also asked for tenders for 30,000 tons of steam coals, c.i.f. Riga, but in this instance the tenders had to be in by the end of June, so that it is fully expected that that order will also be secured by competitors. Apart from these inquiries, the inquiry from abroad is at a standstill. It is obvious to both buyers and sellers that no business can be done until our coal troubles have been terminated. The import trade has been on a moderate scale. Iron ore and pitwood imports have been especially quiet, but iron and steel goods have been fairly active, the latter being brought from Antwerp and Ghent. At Swansea three cargoes of petroleum from Abadan arrived last week, the aggregate cargoes amounting to over 7,000,000 gallons.

The Tin-plate Trade

At the annual meeting of the workmen's side of the Joint Industrial Council of the Welsh Tin and Sheet-plate Industry on Monday at Swansea, the establishment of a research department was approved of, and a committee was appointed to go into the question and see whether the central executive of the various unions was prepared to do anything to further the object. It was also decided that the Joint Industrial Council should be asked to discuss the principles of a scheme for the superannuation of tin-platers. With regard to the agitation in connection with the proposed alteration of the sliding scale, the secretary's report mentioned that the employers had agreed that a certain number of works should submit their accounts for examination in order to test the accuracy of the statements put forward from the employers' side earlier in the year with regard to the costs of production.

The Death of Mr. W. H. Renwick, of Cardiff.

Cardiff has lost a notable citizen in the death of Councillor W. H. Renwick, which occurred on Monday. Mr. Renwick, who was sixty-one years of age, was a native of Newcastle-on-Tyne, where he was born on January 7th, 1865, and where he was educated at the Royal Grammar School. He entered into business with his brother, Sir George Renwick, as shipowner and shipbroker, and came to Cardiff in the early 'nineties to take charge of the local branch of Messrs. Fisher, Renwick and Co. He became closely identified with the patent fuel industry at Swansea, and since 1903 had devoted a large measure of time to municipal affairs, his services to the city being of exceptional value.

Tin-plate Trade.

Some of the works are now working on imported coal, but the majority of them are at a standstill. It is calculated that not more than 10 per cent. of the tin-houses are working. Business is mainly in stock tin-plates, for which prices have advanced to 25s. 6d. basis I.C. f.o.b. works port. A certain amount of business has been done for plates manufactured from foreign bars and imported coal, for which 1s. per box less has been asked. Very little export business is being negotiated, owing to the uncertainty as to delivery. The home demand for the plates available is keen, but for odd sizes for delivery after our coal troubles are settled 20s. 6d. basis f.o.t. works is quoted.

CATALOGUES.

NORTON COMPANY, Worcester, Mass., U.S.A.—Booklet entitled "Grinding in Railroad Repair Shops."

BRITTAIN'S ELECTRIC MOTOR COMPANY, 110, Cannon-street, E.C. 4.—Leaflets on single-phase and polyphase motors.

NEGRETTI AND ZAMBRA, 38, Holborn-viaduct, E.C. 1.—List T 12, dealing with all types of thermometers for aircraft.

D.P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Brochure on acid and water testing with relation to batteries.

DOWDING'S MACHINE TOOL COMPANY, Ltd., Bush House, Aldwych, W.C. 2.—Lists of new and second-hand machine tools for sale.

BROOKHURST SWITCHGEAR, Ltd., Northgate Works, Chester.—A recent publication entitled "Voltage Control on Loaded Distributors."

HOLLINGS AND GUEST, Ltd., Thimble Mill-lane, Birmingham.—Hydraulic baling press list No. A 102, giving a large selection of baling presses for waste paper, cotton, wool, &c.

JAMES KEITH AND BLACKMAN COMPANY, Ltd., 27, Farringdon-avenue, E.C. 4.—Booklet illustrating and describing steel tube air heaters; also one dealing with cupola fans.

BURROUGHS, WELLCOME AND CO., Snow-hill Buildings, E.C. 1.—A booklet, entitled "Safety First," which compares the old methods of photography with those of the present day.

HERBERT SMETHURST AND SONS, Ollerton Works, Knutsford, Cheshire.—Illustrated pamphlet dealing with the Smethurst patented antiseptic air diffuser and "Seasone" germicide essence.

THE VACUUM OIL COMPANY, Ltd., Caxton House, Westminster, S.W. 1.—Publication No. 24 of the "Gargoyle Technical Series," entitled "The Horizontal Steam Turbine for Stationary Plants."

REES ROTURBO MANUFACTURING COMPANY, Ltd., Wolverhampton.—Pamphlet R 232, describing in detail self-contained pumping sets, and R 233 dealing with pumps for acid, liquor and chemical trade liquids.

BRAITHWAITE AND CO. (ENGINEERS), Ltd., Broadway Buildings, Westminster, S.W. 1.—An illustrated booklet on the "Braithwaite" pressed steel tanks, which are made in sections for assembly on the site.

THE HARLAND ENGINEERING COMPANY, Ltd., Alloa, Scotland.—New edition of the pamphlet covering a complete range of "Harland" ball bearing alternating-current motors, ranging from 1 to 60 horse-power.

THE MARCONIPHONE COMPANY, Ltd., 210–212, Tottenham Court-road, London, W. 1.—Publication No. 364 F. Illustrated catalogue and price list of Marconiphone and Sterling radio receivers, accessories and components.

WAYGOOD-OTIS CLUB NEW SPORTS GROUND.—The Waygood-Otis Club opened its new sports ground at Elmers End on Saturday afternoon last. The Waygood-Otis Club arose out of a friendly match between the office and works of the what was then Waygood and Co., Ltd., which took place at a beanfeast given by the company in Richmond Park in 1891. It developed into a cricket club for only one eleven and had a membership of about forty. Later a football section was formed in 1904 with a membership of about fifty. At first the cricket club played its matches at Brown's Fields, Nunhead, but in 1906 it succeeded in procuring a ground some 5½ acres in extent at Whitefoot-lane, Bellingham. The cricket and football clubs developed into a general club, comprising cycling, bowling and lawn tennis sections, for athletic events and social entertainment generally, and the club organises winter entertainments once a month, when the members indulge in dancing, whist drives, concerts, &c., and there is an annual swimming gala and a sports meeting. The new ground just opened comprises nearly 10 acres, the freehold of which has been purchased by the company, which is granting a lease to the club at a nominal rent. The ground will accommodate two cricket pitches, four tennis courts, one bowling green, and football pitches during the season.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 6	—
No. 1 Foundry	4 5 0 to 4 7 6	
No. 3 Foundry	4 0 0 to 4 2 0	
N.E. COAST—		
Hematite Mixed Nos.	3 19 0	3 19 0
No. 1	3 19 6	3 19 6
Cleveland—		
No. 1	4 6 6	4 7 0
Silicious Iron	4 6 6	4 7 0
No. 3 G.M.B.	4 4 0	4 4 6
No. 4 Foundry	4 3 0	4 3 6
No. 4 Forge	4 2 6	4 2 6
Mottled	4 1 6	4 2 0
White	4 1 6	4 2 0
MIDLANDS—		
(5) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 10 0	
,, Forge	2 16 0 to 2 17 0	
(3) Derbyshire—		
No. 3 Foundry	3 7 6 to 3 15 0	
Forge	3 2 0 to 3 5 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (a) / 4 10 0 (b) / 4 15 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 5 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 17 6	7 0 0
Sections	7 7 6	6 5 0
Steel Sheets, under 3/16in. to ½in.	9 12 6	—
Sheets (Gal. Cor. 24 B.G.)	— £16 0 0 to £17 0 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 17 6	—
Angles	7 10 0	—
Boiler Plates	11 10 0	—
Joists	7 10 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†..	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 10 10 0†	
MANCHESTER—		
Bars (Round)	8 10 0	—
,, (others)	8 10 0	—
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	8 2 6	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—	(*Nominal: none on offer.*)	
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	6 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 2 6	
Billets and Sheet Bars	6 2 6 to 6 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 10 0 to 15 15 0	
Angles	7 2 6 to 7 7 6	
Joists	7 2 6 to 7 7 6	
Tees	8 2 6 to 8 7 6	
Bridge and Tank Plates	7 17 6 to 8 2 6	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	24/6 to 25/6
Block Tin (cash)	272 5 0
,, (three months)	271 12 6
Copper (cash)	57 0 0
,, (three months)	57 15 0
Spanish Lead (cash)	30 3 9
,, (three months)	30 3 9
Spelter (cash)	33 12 6
,, (three months)	33 12 6
MANCHESTER—	
Copper, Best Selected Ingots	63 12 6
,, Electrolytic	66 0 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 0½
Brass Tubes (Basis Price)	0 0 11½
,, Condenser	0 1 2
Lead, English	32 10 0
,, Foreign	31 2 6
Spelter	34 7 6

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£38 10 0	12/6
,, ,, 1 p.c. ,,	£44 10 0	15/–
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5½d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 5 0 scale 5/– per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/– per unit	
,, Vanadium	15/– per lb.	
,, Molybdenum	6/– per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/– per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND. (*Prices nominal.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/9
,, ,, Ell	16/6
,, ,, Splint	16/6 to 17/–
,, ,, Trebles	15/9
,, ,, Doubles	14/– to 14/6
,, ,, Singles	13/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	16/9
,, ,, Jewel	17/– to 17/6
,, ,, Trebles	17/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/9
Screened Navigation	21/–
Trebles	14/– to 15/–
Doubles	14/–
Singles	13/– to 13/6
LOTHIANS	
(f.o.b. Leith)—Best Steam	14/– to 14/3
Secondary Steam	13/6
Trebles	14/6 to 14/9
Doubles	13/6
Singles	13/6

ENGLAND.

(8) N.W. COAST—	
Steams	*No quotation.*
Household	,, ,,
Coke	,, ,,
NORTHUMBERLAND—	
Best Steams	16/–
Second Steams	14/6 to 15/–
Steam Smalls	8/– to 8/6
Unscreened	13/– to 13/6
Household	20/– to 22/–
DURHAM—	
Best Gas	18/6 to 19/–
Second	15/– to 15/6
Household	20/– to 22/–
Foundry Coke	18/– to 20/–

SHEFFIELD	Inland. (*Nominal: none on offer.*)
Best Hand-picked Branch	31/– to 34/–
Barnsley Best Silkstone	28/– to 30/–
Derbyshire Best Brights	26/– to 28/–
,, ,, House	24/– to 25/–
,, ,, Large Nuts	17/– to 20/–
,, ,, Small	12/6 to 14/–
Yorkshire Hards	17/– to 19/6
Derbyshire Hards	16/– to 19/–
Rough Slacks	10/– to 12/6
Nutty Slacks	7/6 to 9/–
Smalls	3/6 to 6/–
Blast-furnace Coke (Inland)*	—
,, ,, (Export) f.o.b.	16/– to 17/–

(9) SOUTH WALES. (*All prices nominal.*)

CARDIFF— Steam Coals:	
Best Smokeless Large	26/– to 27/–
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/– to 25/–
Ordinary Dry Large	21/– to 22/–
Best Black Vein Large	25/6 to 26/–
Western Valley Large	24/6 to 25/–
Best Eastern Valley Large	24/– to 25/–
Ordinary ,, ,,	23/6 to 24/–
Best Steam Smalls	17/– to 18/–
Ordinary ,,	16/– to 17/–
Washed Nuts	19/– to 26/–
No. 3 Rhondda Large	26/6 to 27/–
,, ,, Smalls	18/– to 18/6
No. 2 ,, Large	24/– to 25/–
,, ,, Through	20/– to 21/–
,, ,, Smalls	15/– to 16/–
Foundry Coke (export)	40/– to 50/–
Furnace Coke (export)	25/– to 30/–
Patent Fuel	22/– to 24/–
Pitwood (ex ship)	26/6 to 27/6
SWANSEA— Anthracite Coals:	
Best Big Vein Large	39/– to 40/–
Seconds	32/6 to 35/–
Red Vein	27/– to 29/–
Machine-made Cobbles	47/6 to 50/–
Nuts	47/6 to 50/–
Beans	42/6 to 44/–
Peas	23/– to 25/–
Breaker Duff	7/6 to 8/–
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/– to 22/–
Smalls	11/– to 15/–
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/–, with fluctuations according to analysis; open market 17/6 to 19/– at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

International Rail Union.

THE statement to the effect that the recent conference in London of representatives of railmakers in Great Britain, France, Belgium, Germany and Luxemburg had cleared up all the difficulties that stood in the way of the definite constitution of the international rail union appears to have been premature. It is certain that all parties are very near agreement, but continental railmakers failed to impress upon British firms the advisability of including the British Dominions in their quota of foreign trade, and for some time the negotiations were at a deadlock, both sides finally deciding to postpone the meeting in the hope of finding some acceptable compromise. Continental firms are so anxious to get the union into working order that they affect to make light of the difficulty, which is nevertheless sufficiently serious, for obviously there can be no compromise which aims at turning the British Dominions into foreign markets.

Works in Algeria.

Notwithstanding the lack of financial support from the State, which has voted credits for colonial public works without being able to provide the money, several of the African colonies are making satisfactory headway with the construction of roads and railways, the equipment of harbours and even the carrying out of hydro-electric installations with the aid of local resources. This is particularly the case with Algeria, which is practically governed by the commercial and industrial communities, and the policy pursued for a long time past has been based upon the idea that taxation for the carrying out of public works is the best form of national investment. Periodical meetings are held to discuss the programmes of public works and to fix the taxation required to permit of their being carried out. For 1927 the total expenditure is estimated at 160,560,000 francs, including 15 millions for the construction of new railways, 30 millions for improving the equipment of existing railways, 17 millions for road construction, 30 millions for hydraulic works, and 15 millions for ports and harbours. This total exceeds the amount voted for the present year by 56 million francs. The hydraulic works to be put in hand include the construction of the Tielat Dam in the department of Oran.

Paris Water Supply.

The Paris Municipal Council will shortly discuss a proposal to vote a sum of 800,000 francs in order to resume the prospecting work which was carried out in the Val de Loire in 1921, with results that were regarded as highly encouraging. It is estimated that Paris can be supplied with a million cubic metres of water from this subterranean source a day. That would be amply sufficient to satisfy all future needs, and as the water can be obtained by pumping it to the surface and sending it mainly by gravitation to Paris the scheme is regarded with so much favour as to encourage its promoters to continue their efforts to secure this practically inexhaustible source of supply, despite the uncompromising opposition of the local populations. The people of the district complain that the raising of such huge quantities of water from the Val de Loire would have the effect of lowering the level of the river at a time when so much money is being spent upon works to render the Loire navigable, and that it would deprive the region of water which is necessary for irrigation purposes. The object of the Municipal Council in resuming its operations is to convince the local authorities that there will be no appreciable variation in the underground water level. It is doubtful, however, whether the Council will be able to dispose of such a large sum of money.

Labour Troubles.

The dockers' unions are continually causing trouble at the ports. Matters came to a head last week when a lock-out was proclaimed at Dunkirk in response to the attitude of the men who demonstrated how little it was possible for a man to do when he was dissatisfied with the wages paid him. The union has been taking every advantage of the periods of shipping activity to insist upon an advance in wages, which had to be granted to avoid a dislocation of business. On piecework the men were then earning from 60 francs to 100 francs a day, which was far more than the wages paid at other ports, and when the union asked for a further advance, which would bring a man's earnings up to something like 180 francs a day, the port "Defence Committee" replied by fixing a daily wage of 38 francs. The men showed how far they disagreed with this decision by doing as little work as possible, and the Committee had no alternative but to declare a lock-out. A similar state of things exists at Boulogne, where the dockers are out on strike.

Railway Accident.

By an accident to an express train from Paris to Bordeaux seven passengers lost their lives and more than forty were injured. The train was nearing Vouvray when the locomotive left the rails, and, after travelling on the ballast for some distance, turned over, the first coaches telescoping into each other. It was at that time running on a straight stretch at a speed of 50 miles an hour. The accident was attributed to a spreading of the rails, but a later official explanation was to the effect that one of the front bogey wheels of the locomotive broke off the axle.

Foreign Trade.

The trade returns for the first five months of the year accentuate the growing margin of imports over exports so far as values are concerned, this being due to the higher prices that have to be paid for essential products purchased abroad. Of the total value of 24,233 million francs for imports, raw material accounted for 16,756 million francs. On the other hand, the exports of manufactured goods were valued at 14,006 million francs out of a total of 22,051 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

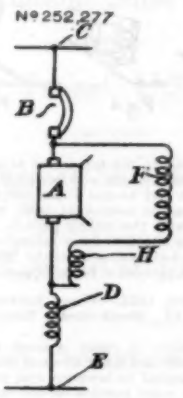
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

252,277. February 25th, 1925.—IMPROVEMENTS IN OR RELATING TO DYNAMO ELECTRIC MACHINERY, Edward Percy Hill, of 133, Davyhulme-road, Stretford, Manchester, and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

Use is made of the sudden partial de-magnetisation of the main field due to the increase of armature reaction on short circuit. This induces an electromotive force in the conductors embracing the magnetic circuit, such as will tend to increase the normal field current. This electromotive force is followed by a similar electromotive force in an opposite direction when the armature reaction diminishes. As shown in the sketch,

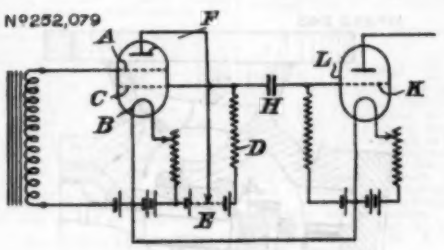


the armature A is connected through the normal circuit breaker B to the conductor C, and at its other side through the normal interpole winding D to the conductor E. There is a shunt circuit directly across the armature, which comprises the shunt field windings F of the machine and an auxiliary interpole winding H. When the load current increases, thereby increasing the armature reaction, the current in the field winding F and the auxiliary interpole winding H is increased, thereby over-exciting the interpoles. When the load decreases the armature reaction is diminished, thus causing a diminution of the current in the field winding F and the auxiliary pole winding H. Thus the interpoles are under-excited during such time as the load is diminishing.—*November 25th*, 1925.

TELEGRAPHS AND TELEPHONES.

252,079. February 18th, 1925.—IMPROVEMENTS IN OR RELATING TO FOUR-ELECTRODE VALVES AND TO MEANS FOR OBTAINING HIGH-FREQUENCY OR LOW-FREQUENCY MAGNIFICATION OR RECTIFICATION THEREWITH, Marconi's Wireless Telegraph Company, Ltd., of Marconi House, Strand, London, W.C. 2, and Ernest Walter Brudenell Gill, of Merton College, Oxford.

This invention relates to four-electrode valves, and to means for obtaining high-frequency or low-frequency magnification or rectification therewith. The outer grid of a four-electrode valve is spaced from the inner grid a distance such that when using cylindrical grids, the ratio of the diameter of the outer grid to the diameter of the inner grid is not less than 2·5 : 1, and is not greater than 5 : 1. Or, alternatively, the diameter of the outer grid is not less than 2½ times the diameter of the inner grid, and does not exceed its length. When using flat grids, the distance from the outer grid to the inner grid must exceed the distance from the inner grid to the filament and be less than its length. When a high resistance is connected in the circuit of the inner grid and a suitable negative potential applied to the outer grid, the valve is capable of giving very large high frequency or low frequency magnification. The

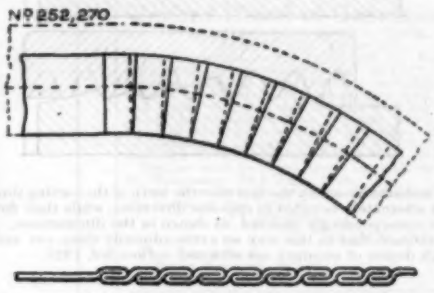


valve can also be used for rectification. When using the valve for magnification, if a resistance of 20,000 ohms be connected in the inner grid circuit of the valve and a positive potential of 40 volts applied thereto, the plate being maintained at a positive potential of 22 volts, the current flowing to the inner grid circuit is ·8 milliampères approximately, when there is zero potential on the outer grid. If a negative potential of ·5 volts is applied to the outer grid, the inner grid current increases by ·4 milliampères, and therefore there is a change of 8 volts in the inner grid circuit, representing a magnification by 16 of the ·5 volts change applied to the outer grid. If the resistance in the inner grid circuit be increased to 50,000 ohms and the potential thereof be increased to 70 volts, then when the outer grid potential is altered from zero to −·5 volts, the current through the inner grid circuit increases by ·4 milliampères, and therefore there is a voltage change in the inner grid circuit of 20 volts, representing a magnification by 40 of the ·5 volts applied to the outer grid. The oscillations to be magnified are applied between the outer grid A and cathode B of a four-electrode valve, the inner grid C of which is charged through the resistance D by means of the battery E. The anode F is maintained at a positive potential lower than that of the inner grid, and the magnified oscillations are coupled through the condenser H to the grid K of a triode L.—*May 18th*, 1926.

TRANSMISSION OF POWER.

252,270. February 24th, 1925.—NOISELESS GEAR BLANKS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2, and H. W. H. Warren, Lynn, St. Andrew's-road, Earlsdon, Coventry.

This invention is concerned with the manufacture of blanks, for friction discs or gear wheels, from layers of textile material. The inventors point out that the usual methods of making such wheels entail the production of a large amount of scrap. With their

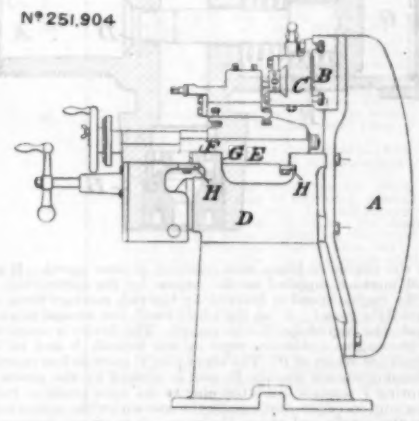


method, however, this waste is eliminated. The blank is made of a ribbon of textile material, impregnated with a binder, such as synthetic resin. The ribbon is pleated, as shown in the illustration, in order to allow of its being wound on to the centre of the blank. The whole mass is then heated and compressed to bind it together. It is claimed that the variation in thickness of the fabric caused by the pleating is immaterial.—*May 20th*, 1926.

MACHINE TOOLS AND SHOP APPLIANCES.

251,904. January 12th, 1926.—TURNING LATHES, W. B. Lang and J. M. Lang, Mary-street, Johnstone, Renfrewshire.

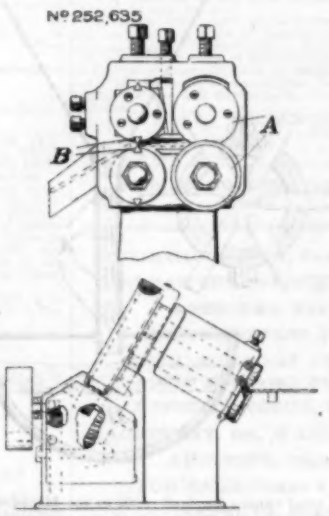
This invention is concerned with lathes in which the back centre, or loose headstock, runs on a bed separate from that for the tool saddle, and aims at making the machine as rigid as



possible. For this reason the brackets A, which carry the supplementary bed B, that carries the tailstock C, are bolted hard up against the saddle bed D at the back. The saddle E is guided along the front shear of the main bed by the faces F and G, and plates H and H are provided to resist any tendency of the saddle to lift.—*May 13th*, 1926.

252,635. December 17th, 1925.—BEVEL SHEAR AND SCRAP CUTTER, L. Williams, 312, North Center-street, Marshalltown, Iowa.

This invention is concerned with the shearing of the edges of steel plates on a bevel, such as is common for caulking purposes,

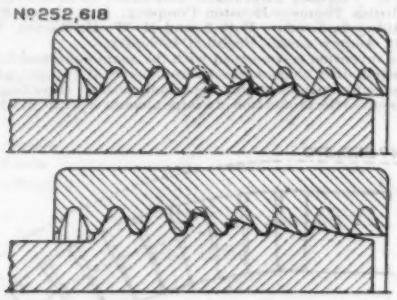


and with the resultant scrap, which, it is stated, is produced in such a curly state that it is very difficult to dispose of. In the machine in question the shearing is effected by a pair of discs A A and the scrap edge is chopped up into short lengths by the rotary cutters B B. These short lengths, it is claimed, are much

more easily handled than are the usual curly strips.—*June 3rd*, 1926.

252,618. November 5th, 1925.—A SCREW-CUTTING TOOL, E. Baumann, Rathansufer 22, Dusseldörf, Germany, and A. Strasmann, Reinscheid-Ebringhausen.

It is to be presumed that this tapping tool is intended for use in a machine where it will have a definite feed into the work.

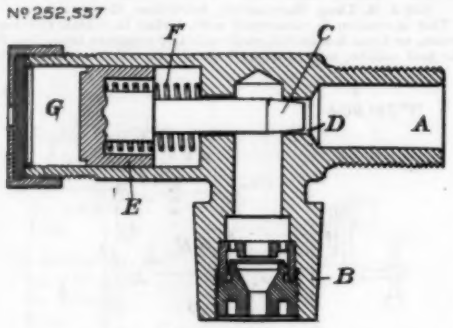


It is characterised by the fact that the teeth of the cutting thread are alternately bevelled in opposite directions, while their flanks are correspondingly relieved, as shown in the illustrations. It is claimed that in this way an extraordinarily clean cut and a high degree of accuracy are attained.—*June 3rd*, 1926.

MOTOR CARS AND ROAD TRAFFIC.

252,557. June 23rd, 1925.—VACUUM TYPE FUEL FEED SYSTEMS FOR INTERNAL COMBUSTION ENGINES, J. Higginson, Autovac Works, Heaton Norris, Stockport.

This invention relates to fuel feed systems of internal combustion engines of the type in which the fuel is raised by vacuum into an intermediate vessel and passed under gravity to the engine carburetter. With this system it is found that when the vacuum which is derived from the engine induction pipe is applied to the intermediate vessel, a mixture of air and fuel, relatively rich in fuel, is drawn into the induction pipe and causes a variation in the running of the engine, such variation being noticeable

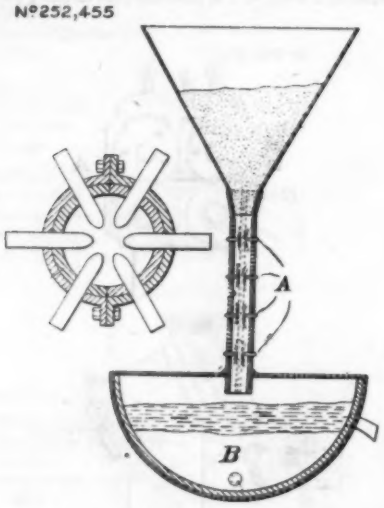


when the engine is idling and rotating at slow speed. If the normal mixture supplied to the engine by the carburetter be rich, the engine speed is lowered by the rich mixture from the intermediate vessel; if, on the other hand, the normal mixture be weak, the engine speed is increased. The device is connected with the engine induction pipe by the branch A and to the intermediate vessel at B. The taper plug C more or less restricts the communicating passage D, and is worked by the piston E. The spring F tends to push the plug to the open position, but if the vacuum increases abnormally the suction on the piston overcomes the spring and closes the plug. G is an air dashpot.—*June 3rd*, 1926.

METALLURGY.

252,455. February 26th, 1925.—ELECTRIC FURNACES, D. Croese, 202, Noordeinde, The Hague, Holland.

In this specification it is stated that the extraction of metals from the deposits of titaniferous iron sand which exist in great quantities in various parts of the world has hitherto been impossible on a commercial scale, owing to the difficulties, first,

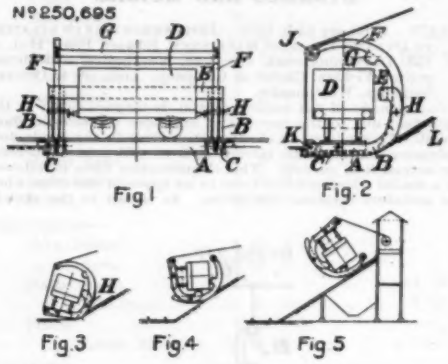


that iron sand cannot be dealt with in the blast-furnace, and secondly, that the melting of a heap of iron sand in the ordinary type of electric furnace entails so great a consumption of electrical energy that production by the blast-furnace from ordinary iron ore remains the cheaper commercial method of producing iron and steel. According to the invention, however, the production of metal from iron sand is effected on a commercial scale by causing the iron sand to fall by gravity through a vertical electric furnace, so arranged as to provide an unobstructed path for the iron sand which encounters successively a number of arcs formed between pairs or groups of electrodes disposed at different stages in the height of the furnace which communicates at its base with a crucible for the reception of molten metal and slag. In the drawing the electrodes are shown at A A and the receiving crucible at B.—*May 26th*, 1926.

MISCELLANEOUS.

230,695. January 23rd, 1925.—WAGON TIPPLERS, B. E. Ellson, 57, Queen's-road, Richmond, Surrey.

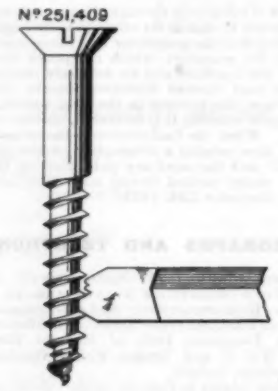
In this tippler a table A is provided for receiving the wagon D, and is pivoted at each end at C with pins mounted in the bottom ends of the side frame. The side frame is composed of the end beams B coupled together by the chock E, the beams B and chock E being firmly connected together as one rigid unit. The



side frame is pivoted to the top frame at each end at H. The top frame is composed of the end beams F coupled together by the chock G. The end beams F are carried downwards or in an inclined direction to terminate with rollers which are in contact normally with the rolling path L, thus preventing the top frame with the chock G from falling over and downwards towards the wagon top until so desired. The three smaller views show a truck in the process of being tipped.—*April 22nd*, 1926.

251,409. June 15th, 1925.—WOOD SCREWS, Guest, Keen and Nettlefolds, Ltd., Heath-street, Birmingham, and G. W. Farrow.

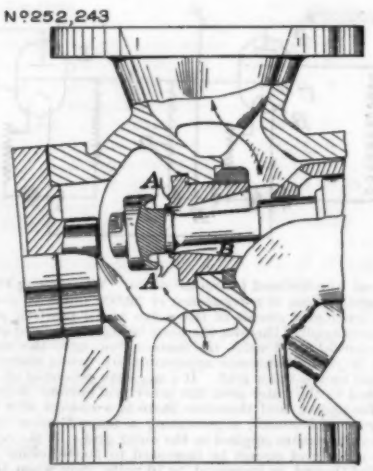
In this specification a claim is made for "a wood screw wherein one or more auxiliary threads smaller than the main thread is or are formed in between and overlapping the main thread on a gimlet point portion on the end of the main barrel



of the screw, said barrel and point portion being so shaped that throughout the length of the screw each portion thereof between adjacent thread turns, whether main or auxiliary, has its sides parallel with the sides of the portion between the previously adjacent thread turns." The drawing, which shows the forming tool, is self-explanatory.—*May 13th*, 1926.

252,243. February 19th, 1925.—SAFETY VALVES, Cockburns, Ltd., and D. MacNicoll, Cardonald, near Glasgow.

This safety valve is intended for working at high pressures, say, round about 800 lb. per square inch, and the object aimed at is to prevent the seating faces from being scored by high velocity steam. In the drawing the working faces are shown at A A.



When the valve is opened the steam must pass between these faces and also through the clearance B between the valve steam and seating bush. The cross-sectional area of this clearance is made so much smaller than the opening between the valve faces that the steam cannot attain a detrimental velocity across the seating faces.—*May 19th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

BRITISH WATERWORKS ASSOCIATION.—Meeting at Bristol. For programme, see page 649.

MONDAY, JULY 5TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London. General meeting of members. 5 p.m.

TUESDAY TO SATURDAY, JULY 6TH TO 10TH.

ROYAL AGRICULTURAL SOCIETY.—Show at Reading.

MONDAY TO FRIDAY, JULY 19TH TO 23RD.

CONGRESS OF CHEMISTS.—In London. For programme, see page 646.

SATURDAY JULY 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting at Paignton. 11 a.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE ELEKTROTECHNISCHER VEREIN asks us to announce that it has changed its address from Potsdamerstrasse 68, Berlin, W. 57, to Potsdamerstrasse 118a, Berlin, W. 35.

MARRYAT AND PLACE ask us to state that during the partial rebuilding of Nos. 28 and 29, Hatton-garden, they have moved their offices to 40, Hatton-garden, London, E.C. 1, and request that all future correspondence shall be addressed to them at the latter address.

WE are asked to state that Engineer Vice-Admiral Sir Robert B. Dixon, K.C.B., the Engineer-in-Chief of the Fleet, has been offered and has accepted the presidency of the Junior Institution of Engineers for the year 1926–1927, in succession to Mr. J. S. Highfield, M. Inst. C.E., M.I.E.E. Sir Robert Dixon's induction will take place in December next.

JOHN LE BOUTILLIER, Ltd., 57, Bishopsgate, London, E.C. 2, informs us that it has been advised by its principal, the Maschinenfabrik Augsburg-Nürnberg A.G., that arrangements have been completed by which Vickers Ltd., Barrow-in-Furness, will in future manufacture single and double-acting oil engines of the marine and stationary types, in accordance with the M.A.N. construction.

THE STEEL BAND CONVEYOR AND ENGINEERING COMPANY, Ltd., of Barker-street Works, Parade, Manchester, informs us that it is acquiring the assets and goodwill of the business hitherto carried on as "Steel Belts, Ltd.," of Vesta-street, Mill-street, Ancoats, Manchester, and that, as soon as the transaction is completed, the latter company will be wound up. Mr. H. Blackburn, who till now has been managing director of Steel Belts, Ltd., will join the new company, but will for the present remain in Manchester.

THE FRIED KRUPP GRUSONWERK AKTIENGESELLSCHAFT, of Magdeburg-B., asks us to state that its present representative, Mr. W. Stamm, of 63, Queen Victoria-street, London, E.C., is now desirous of being to some extent relieved of the work in connection with its representation in the United Kingdom, and that it has therefore concluded arrangements with Messrs. J. Rolland and Co., Abbey House, 2, Victoria-street, London, S.W. 1—telephone (two lines), Victoria 1328, 4847; telegrams, Jonrolla Sowest London—to take over its representation as from July 1st. Mr. Stamm will still continue to take an active part in the business and will collaborate with Messrs. J. Rolland and Co. in the working of the agency.

CONTRACTS.

FULLER'S UNITED ELECTRIC WORKS, Ltd., of Chadwell Heath, has received an order to supply 736 of its TG 13 type train-lighting cells, each of 180 ampère-hour capacity, to the Bombay, Baroda and Central India Railway.

SIR WILLIAM ARROL AND CO., Ltd., Parkhead, Glasgow, have received an order for twenty-one "Arrol-Whitaker" electric power navvies for excavation work. It is believed that this is the largest single order ever placed for electric shovels.

FOAMITE FIREFOAM, Ltd., of 24–26, Maddox-street, Regent-street, London, W. 1, has received an order from the Anglo-Persian Oil Company, Ltd., for a Foamite installation for the protection of the large oil tanks on the transit site near Swansea.

JOSEPH KAYE AND SONS, Ltd., of Lock Works, Leeds, inform us that they have recently received an order from the Great Western Railway for 2000 of their latest patented automatic wedge locks, including also their new patented combined cam striking plates.

ROBERT DEMPSTER AND SONS, Ltd., have received an order from the County of London Electric Supply Company, Ltd., for the coal-handling plant, comprising two 100 tons per hour gravity bucket conveyors and a 25-ton per hour telpher plant over storage bunkers, for the extensions of the electric super-power station at Barking.

THE "I.O. EMMAS'" REUNION.—On Friday, June 25th, a reunion of former Inspectors of Ordnance Machinery, Royal Army Ordnance Corps, sat down to dinner at the Holborn Restaurant, with Major G. R. Rosevere, M.I. Mech. E., in the chair. The guests included Colonel D. Paul, Colonel P. G. Davies, Colonel C. W. Everett, Lieut.-Colonel W. A. Quennell, M.I. Mech. E., and Lieut.-Colonel J. J. Mills. Colonel P. G. Davies detailed the history of the Inspectors of Ordnance Machinery branch of the service since its formation, and explained the reasons for the change in title from "Inspector of Ordnance Machinery" to "Ordnance Mechanical Engineer." He also emphasised the growth and importance of the department. A general meeting was held early in the evening, and it was unanimously decided to make this reunion an annual event, and to form an association forthwith. Colonel P. G. Davies, Chief Ordnance Mechanical Engineer, War Office, said he very strongly supported the movement, and appealed to every former Inspector of Ordnance Machinery not in touch with the honorary secretary to communicate as soon as possible with Captain J. A. Spencer M.I. Mech. E., 104, Lytton-avenue, Letchworth, Herts.